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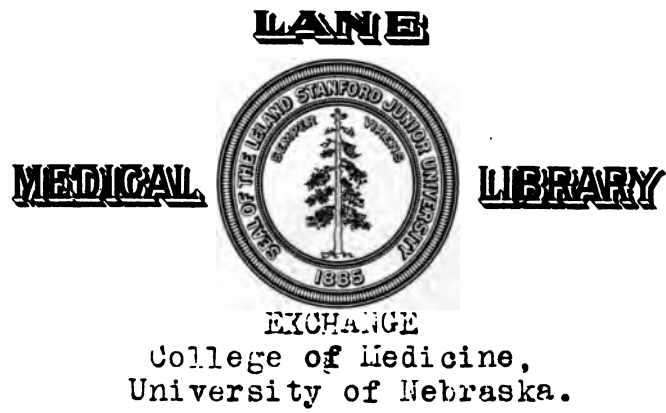
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ROBERT CAMERON McDONALD, M. D.
BORN PERTH, ONTARIO, CANADA
JUNE 5, 1859
DIED FREMONT, NEBRASKA
APRIL 3, 1914

Robert McDonald

THE NATIONAL
Association of Railway Surgeons

OFFICIAL REPORT
OF THE
SIXTH ANNUAL MEETING

HELD AT
OMAHA, NEBRASKA
MAY 31, JUNE 1 and 2, 1893.

EDITED BY
R. HARVEY REED, M. D.
MANSFIELD, OHIO.

PUBLISHED BY
THE RAILWAY AGE AND NORTHWESTERN RAILROADER
CHICAGO, ILLINOIS
1893



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CHAPTER I.

PROCEEDINGS OF THE NATIONAL ASSOCIATION OF RAILWAY SURGEONS.

Sixth Annual Convention, held at Omaha, Neb., May 31
and June 1 and 2, 1893.

(Reported by the Official Stenographer, R. A. Smith, Omaha, Neb.)

FIRST DAY—MORNING SESSION, WEDNESDAY, May 31.

The association convened in the exposition hall, and was called to order by the chairman of the committee of arrangements, Dr. W. J. Galbraith, of Omaha, Neb., at 10:30 a. m.

Prayer was offered by the Rev. T. J. Mackay, rector of All Saints Church, Omaha, Neb.

The address of welcome was then delivered by Hon. John M. Thurston, general solicitor of the Union Pacific Railway, Omaha, Neb.

ADDRESS OF WELCOME.

[By HON. JOHN M. THURSTON, General Solicitor Union Pacific Railway System.]

Mr. President and Gentlemen of the Convention: I have no set phrases in which to address you this morning. I conceive that Omaha's welcome should be as simple as it is sincere. We conceive that we are highly honored in welcoming to our city so distinguished a representative body of men. You need present no letters of introduction, for we are well aware that men who have risen in their several communities to fill the positions which you fill, to hold the respect of your fellow citizens as you must, who have been so well thought of as to receive appointment by the railroads of the country—those corporate instrumentalities which never make mistakes in the employment of men for high positions—that you come here with your certificates of character already earned and sealed with your own works; and we know that you represent the highest order of mental and moral work. Gentlemen, the city of Omaha is yours, and the fullness thereof. We hope, however, you will not carry away all the fullness thereof. Not only is our latch string on the outside, but every door in the city is open to you. It may be well, however, to warn you that there are open doors in this city that you should avoid. And we must confess that we have among us, as there are found in other communities, those who follow the scriptural injunction and "take the strangers in." (Laughter.)

This is a peaceful and law-abiding community in which you find yourselves. Its location here, in what many of you may consider the far west, may have filled you with apprehension as to the chances you would take in being guests of our city, even for a few days. But I am here to assure you, gentlemen, that our best citizens never strap on their guns until after sunset, and the curfew in Omaha is tolled at the rising of the sun. (Applause.)

This is a practical country in which you find yourselves. I cannot better illustrate this than call your attention to a circumstance which recently happened in our neighboring city of Deadwood. Everything is practical in the west. We are a rushing, pushing, progressive people. We take advantage of everything that can tend to advance the individual and the general welfare of the commonwealth.

One of the first citizens of Deadwood recently returned from his fifth visit to the "gold cure" institute, and celebrated it with a great "round-up" among the boys. Unfortunately for him, however, he was spied out by an old miner, who immediately located a placer claim upon him and the next day his remains were assayed by the coroner. (Laughter.)

Gentlemen of the convention, the science of medicine has made great strides since the remote ages in which we first find record of it. I took pains to refer to the family Bible for this important occasion, and I discovered the first recorded record of the practice of medicine in Second Chron., 16th Chapt., 12th and 13th verses: "And Asa in the 30 and 9th year of his reign was diseased in his feet until his disease was exceeding great; yet in his disease he sought not to the Lord but to the physicians; and Asa slept with his fathers." (Laughter and applause.) Not entirely satisfied with the record of the Old Testament, I searched the scriptures and in the New Testament in the Gospel of Mark, 16th chapter, 26th verse, and found recorded of a certain woman who had suffered many things of many physicians and

spent all that she had, yet had not become bettered but rather grew worse. (Laughter.)

I cite these illustrations, gentlemen, simply to show you the gigantic strides that have been made in this science, which seems to be the greatest and most blessed science that is known and practiced among men. True it is that in the 19th century no divine healer rolls away the stone from the sepulchre and, with the voice of authority, cries: "Lazarus, come forth;" but instead thereof by every bedside of suffering, by every couch of agony, is a scientifically equipped man with his instruments and his knowledge and his experience to guide him, standing wrestling with the grim messenger, and many, many times overcoming him in splendid degree. There is no greater deed done for the benefit of man than is done by him who ministers to the suffering and distressed. The rewards of valor have been too often apportioned to him who upon the field of carnage has shed the blood of his fellow-man. Modern philosophy, modern civilization and modern humanity crown the hero who wrestles with disease and death and triumphs by his science over even the laws of nature.

Gentlemen, you are welcomed to our midst. We would like to have you pay a visit to every Omaha home, provided always—and these presents, in the language of the law, are upon this express condition—that you leave your weapons at home. We wish your visits to be social; we wish to forget, for the time being, the formality that is incident to the ordinary professional visit that we receive and you pay. We wish to take you into our homes and into our hearts; to take you by the hand and tell you that we recognize your great worth. We rejoice that you are here and appreciate the efforts that you have made for humanity. We are with you, and will help you and aid you in the great progress of the science which has been such a blessing and a boon to man.

The railway surgeon is a modern institution. It is but a few short years ago that, in case of a terrible accident along the line, the suffering and the dying were, from the very necessity of the case, almost abandoned, and for hours, yea, sometimes for days, no help was near. But the institution of the railway surgeon, bringing into immediate relationship with the operating officers of the road of the railway surgeons along the line, has now put an end to all this; and today, from the Atlantic to the Pacific, whenever and wherever a train goes into the ditch and human suffering is the result, some railway surgeon, yea, many railway surgeons, are ready by day and by night, in sunshine and in storm, upon the tap of the electric signal, to be upon the scene almost without the loss of a single moment. They are there to administer to their fellow-men, to help them, to succor them, and to sustain them. Those corporations which, in spite of the contumely in which they are sometimes held, have done much to advance our civilization, to make possible our splendid development, to increase our general prosperity and to bring the producer and the consumer closer together, to accomplish so much in the way of establishing the unity and the progress and the advancement of this grand and glorious country in which we live. Gentlemen, we are glad to see you here to-day for another reason. You come here from every city, village and hamlet in the country; from every section of the United States. Gatherings of this kind tend to make us, as a people, better acquainted with each other; to establish more friendly relationship and to develop the spirit of true Americanism which has made this country the wonder and the admiration of the civilized world.

You are met to-day in a city which is a representative of American pluck, American enterprise and American development. The men who came here in their early manhood in what was so recently the "great American desert," with hearts and hands ready to work and build up what you see about you, are the bravest and best that can be found in any land. The fact that they are here is a warrant for my statement. Those of tenderer kin, with less energy and less courage, did not come out from the parental threshold, did not leave the shelter of home to take their chances in the progressive west. This west is typical of the American idea. We welcome here every man, whether of American or foreign birth, who loves liberty, loves his God, obeys the constitution of the United States and seeks to labor that his family may live in comfort. We teach our children in the public schools American history in order that they may be ready for the responsibilities and the duties of the future. And we recognize the right of every man in the United States, so long as he obeys the laws of his country, to follow whatever vocation he chooses and to labor for himself as he pleases, and to accumulate whatever he can, so long as he does not wrong his neighbor.

Gentlemen, I will not detain you this morning. You have work to do. I hope that this gathering will be productive of great good. I hope it will fill you full of a better understanding of what we have here in the center of the continent; of the grand possibilities of the American people. We are in the midst of a country that has just only commenced its development and its improvement. We stand here with thousands of miles of fertile territory stretching in every direction, capable of sustaining in comfort and in plenty a population the extent of which we can scarcely dream. It is our duty as men to see to it in our respective paths of life that this development and this civilization shall go on upon right lines, in order that humanity's pathway of progress may be upward and onward; that civilization may have no retrogression in this new land of liberty and comfort and of plenty. We are pleased, indeed, that we live in the United States in the 19th century, in a progressive age when men understand each other. We are blessed, indeed, that our children are given the benefit of educational institutions in order that ignorance may not rule the affairs of men. This is the most blessed land of all the earth. This is a land of opportunities. The ancients believed in an Arcadian realm towards which those happy mortals might float on summer seas, and whirl until they saw its golden strand. This is that land. The centuries have given it to human rest; have given it that on its peaceful shores earth's millions might find hope; have given it that those oppressed in other climes might here be free; have given it that its sheltering valleys may abound in happy homes and its fertile soil to bring forth the bountiful gifts of Almighty God. (Applause.)

RESPONSE TO ADDRESS OF WELCOME.

In the absence of Dr. George Chaffee, who was to reply to the address of welcome, the response was made by Dr. Charles K. Cole, of Helena, Mont.

Ladies and Gentlemen: The chairman of the committee of arrangements expresses regret that Dr. Chaffee is not present. I am sure that he does not regret that circumstance as much as I do, and I think I am equally correct in saying that his regret does not exceed that of the members of this association and their friends who are with us this morning. In an unfortunate moment I accepted Dr. Galbraith's invitation to say a few words in behalf of the association. The eloquent words spoken by Judge Thurston in his address of welcome to the National Association of Railway Surgeons deserve a better and more fitting reply than it is possible for me to make at this time. I will content myself by simply saying that by these words so cordially spoken and by other words of equal cordiality spoken by scores of other lips, the citizens of Omaha, the officials of the great Union Pacific railway and the officials of other great railways centering in Omaha have made us to feel the abundance and sincerity of your welcome. We accept your hospitality, so generously extended, in the same spirit in which it is given; and during the three days which we shall be in session here we shall feel constantly that we are among friends—friends not only in a personal sense, but in the sense that the advantages and aims of this association, the ideas and principles which we represent, receive your commendation and approval. The advantages and aims of this association are such that, when they shall be better and more fully understood, we firmly believe they will not only commend themselves to the managers of railroads, but to that portion of the public which is alive to progress and improvement generally.

It is an axiom in the business world that the highest order of talent is required in the successful railway manager. In my humble opinion, if I may be permitted to say so, the sagacity of these gentlemen was never better demonstrated than when they recognized the importance and necessity of securing the services of qualified medical men to organize and conduct the medical departments of their various roads, together with thoroughly equipped hospitals for the care of the sick and injured. This organization, of which the members are for the time being the guests of your beautiful and progressive city, has had a varied experience and has reached its present status after many trials and tribulations; yet, in spite of prognostications of evil and of efforts to kill it off, it has survived; and I leave you to judge as to whether its efforts have been successful when I state to you that this is the sixth annual meeting which will convene to-day in this hall, with nearly 1,000 active surgeons in attendance, who represent nearly every railroad system in almost every state and territory in the United States; besides British America and Old Mexico. Very early in the history of this organization the statement was frequently made that these annual meetings would become mere junketing trips, gotten up for the pleasure and gratification of our members, and made possible by the fact that the railroads would give us free transportation. These and other unpleasant things were said about us, while from other sources we received the rebuke of silent disdain. We abided our time, however, and to-day we are the largest body of surgical workers in the United States—I say the largest body of surgical workers in the country—and if there are any within the reach of my voice who still think that these annual meetings are held as mere pleasure and mere junketing trips for the benefit of our members, I challenge them to watch the course of the proceedings of this meeting.

You are met to-day in a city which is a representative of American pluck, American enterprise and American development. The men who came here in their early manhood in what was so recently the "great American desert," with hearts and hands ready to work and build up what you see about you, are the bravest and best that can be found in any land. The fact that they are here is a warrant for my statement. Those of tenderer kin, with less energy and less courage, did not come out from the parental threshold, did not leave the shelter of home to take their chances in the progressive west. This west is typical of the American idea. We welcome here every man, whether of American or foreign birth, who loves liberty, loves his God, obeys the constitution of the United States and seeks to labor that his family may live in comfort. We teach our children in the public schools American history in order that they may be ready for the responsibilities and the duties of the future. And we recognize the right of every man in the United States, so long as he obeys the laws of his country, to follow whatever vocation he chooses and to labor for himself as he pleases, and to accumulate whatever he can, so long as he does not wrong his neighbor.

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ing the year ending June 30, 1891, these much-abused corporations cared for about 35,000 injured people, paying all expenses incident to their care, board, nursing, hospital charges, surgeons' fees, etc., costing them millions of dollars in the aggregate. No other set of men on the face of the earth are so lavish in dispensing sweet charity, or receive as little credit for it from the general public. In the face of the foregoing facts is it not about time that the carping criticism of railway corporations as "soulless" should cease?

INDEPENDENT JOURNALISM.

The experience of the American Medical Association in journalism should deter us from a like venture for years to come. If, with 6,000 members and 70,000 other physicians from whom to obtain subscribers, and a very large advertising patronage, they find it difficult to keep out of debt, what would be our fate with 1,500 members? It would not take a very astute mathematician to figure out the result.

We now receive the Railway Age weekly, which, in addition to information of a general character concerning railways, furnishes us with an ably conducted department devoted to railway surgery, a bound volume of the transactions of our association, and in many other ways gives us their assistance, all for three dollars and a half a year. We are prospering beyond precedent under our present management, and, in my opinion, a change would be exceedingly hazardous, if not destructive.

During the past year I received a circular from the publishers of the Railway Age, in which they proposed to issue the surgical department of that paper in the form of a supplement, and asked me, as an officer of this association, for my endorsement of the proposed change. This I declined to give; first, because to have done so would have been to transcend the authority delegated to me, and, secondly, because I thought it would be defeating the object we had in view in selecting the Age as our organ—namely, the bringing of our work to the attention of railway managements. I feared that this supplement might generally pass unnoticed by all except surgeons.

If the objections made by some to publishing our papers and proceedings in a lay journal have any weight, they can be overcome in the least harmful way by adopting the suggestions of the Railway Age publishers in regard to a surgical supplement to their regular issue.

These enterprising people may have some new scheme to present at this time, and I bespeak for any suggestions and propositions emanating from this source, kind and respectful consideration. Much of our phenomenal growth and success may, in my opinion, be fairly ascribed to the able and skillful conduct of the surgical department of the Railway Age. No matter what plan we may adopt, it must be such as will keep us in touch with the rest of the railway world. But, gentlemen, this is a question which you alone may decide.

INLAND QUARANTINE.

The rigid enforcement of the national, state and municipal quarantine laws may possibly afford us immunity from the invasion of imported epidemic diseases, if harmonious co-operation can be secured. But suppose they should be ineffectual, and cholera, yellow fever or typhus fever should

find a lodgement in one or more of the seacoast cities, cannot something be done to prevent the introduction of these scourges into the interior?

I think that much can be accomplished in this direction; and it behooves us, as the medical representatives of the great railroads of the country, to formulate some general plan to be submitted to the managements for their guidance in this matter; and I respectfully suggest that a committee be appointed who shall take the subject in hand and report at this meeting, if possible, the result of their deliberations.

If we can accomplish something on this line we will have done much, very much, to strengthen the bond of union between the railways and our association from a business standpoint, and will have added immeasurably to the safety, health and happiness of all the inland sections of our country, past experience having shown that epidemics follow the lines of travel.

SEPARATE CARS FOR THE SICK.

At our last annual convention held at Old Point Comfort, Virginia, that able and distinguished railway surgeon, Dr. C. P. Conn, of Concord, New Hampshire, called attention to the necessity of providing separate cars for the conveyance of persons suffering from infectious diseases. This is a question of great practical importance, and one that will soon have to be met and solved by those lines of railway that are the routes to health resorts, particularly the lines traveled by consumptives.

Would it not be practicable to fit cars with compartments, each compartment having all the conveniences for the sick, with sleeping berths for the invalids and attendants, and let it be known that one of these cars would leave, say, Boston, New York, Chicago, St. Louis or Cincinnati on certain days, and that the sick would be transported in one of these cars only. I think it probable that the comfort and convenience of such an arrangement would soon place them in great demand, and would pay the companies using them handsomely. The protection thus afforded to other passengers "goes without saying." Human beings, born to immortality, are entitled to as much protection as the dumb beast, but it is not accorded to them by the laws governing the transportation of the country.

The government has established a "Bureau of Animal Industry," to prevent the exportation of diseased cattle, and to provide means for the suppression and to prevent the dissemination of contagious and infectious diseases among domestic animals, and makes an annual appropriation for the support of the bureau, and assigns a cabinet officer to the head of it. This officer can stop the shipment of domestic animals from any section of the country he may see fit, and issue specific directions how the cars, pens, etc., shall be disinfected. Now, this is as it should be, and shows wonderful foresight and care on the part of our great government in protecting the pockets of her citizens from loss, by the disease and death of their domestic animals. But how is it when you come to human beings? Why, absolutely no protection is afforded them. If there were a money value attached to each individual that would make him equal in value to one of these domestic animals, Congress might be moved to the enactment of laws for the protection of those who are but "little lower than the angels, and created in the image of God Himself." "Man's inhumanity to man makes countless millions mourn."

In this connection there comes to us a valuable suggestion from the Car Journal, and it is this: That this association appoint delegates to the Master Car Builders' Association to consider with them the material to be used in hangings and in upholstering and furnishing coaches. The use of such fabrics as will be least liable to receive and retain disease breeding germs, and will admit of being thoroughly cleaned and disinfected is much to be desired.

I respectfully suggest that this body appoint such a committee, who can, with the Master Car Builders, consider the hygienic features of passenger car construction, their ventilation and maintenance. Besides, the co-operative action of the various railway associations will be productive of good results, and this will be a step in that direction.

PAN-AMERICAN MEDICAL CONGRESS.

In conformity to a joint resolution which passed the Senate and House of Representatives, and approved July 18, 1892, by which the President was authorized to invite the governments of the Western hemisphere to send official delegates to the Pan-American Medical Congress, this body will meet in Washington, D. C., September 5th, 6th, 7th and 8th, 1893.

The organizers of this congress have seen fit to designate railway surgery as a specialty, and have selected a number of the members of this body to whom is intrusted the organization of this section. Like the rest of the gentlemen named, I knew nothing of the intention of the promoters of this scheme until I saw myself announced as the executive president of the section on railway surgery.

Our specialty having thus been recognized, it is our duty to see to it that we appreciate the honor, conferred, by making our section a pronounced success; and I appeal to the members of this association especially to give their aid and support to this end. Gentlemen, we cannot afford to let the part assigned to us go by default.

TARIFF OF FEES.

All discussion of, and legislation upon, surgeons' charges by this association as an association should be avoided. This is a question to be agreed upon between the surgeon and the railway company employing him, and is generally regulated by the local tariff in each vicinage. We stand for reciprocity, a tariff for revenue, for good money and plenty of it, and for our share honestly earned.

RAILWAY SURGICAL CORPS AND THE HOSPITAL PLAN.

A good deal has been written and said in regard to organized surgical corps on railways, and the "hospital plan," but too much cannot be said in commendation of them; and the experience of our western brethren shows that they go hand in hand. They are humane to the last degree, affording to the injured careful and skillful attention at the earliest moment practicable; and every man in the sound of my voice will bear testimony to the fact, if he has been engaged in railway surgical work any length of time, that he is much better fitted to do such work now than when he commenced it. There are many peculiarities that attach to railway injuries which passed unnoticed until surgeons became part of the equipment of nearly all well-appointed railway systems. Experience is

surely a great teacher in this portion of the field of science; and the unkind criticisms that have been flung at it from time to time come from those who write, before they have acquired wisdom born of experience.

The railway hospital plan is another admirable western product; and we of the east are glad to sit at the feet of these western Gamaliels and learn of them how to do these great things.

Mr. Greeley's advice to the young man to "go west" may be followed with great benefit by railway surgeons from the older sections of our country; and when they have seen the superb hospitals and the practical workings of the system they will say, as the Queen of Sheba said after seeing the splendors of King Solomon, "that the half had not been told."

But I must not weary you with subjects of an unprofessional nature, however important and practical they may be. You are eager for the feast of reason in store for you in the execution of our programme, and must not be detained.

But, gentlemen, I know I will be pardoned for a digression before concluding my remarks, and, as a Virginian, you must permit me to express my gratification that my native state has had such distinction conferred upon her sons during the past year. My friend and neighbor, Dr. Hunter McGuire, an honorary member of this association, and known to all of you, is now the president of the American Medical Association; that great lawyer, the Honorable J. Randolph Tucker, is president of the Bar Association of America, and by your kindness I have been similarly honored by this body. Though a large majority of each of these bodies are Northern men, still they have seen fit to bestow these distinctions upon their Southern brethren. And the President of the United States has three Southern men in his cabinet. These are not rewards bestowed upon sycophantic apologists, but rather an expression of confidence, respect and good fellowship.

If there has been cherished for years a wish, a hope above every other, on the part of the Southern people, it has been to see the end of sectionalism. It has never had a place in scientific bodies; science knows neither sections, country nor continents, but claims its votaries and worshipers wheresoever civilization has found a lodgement.

In this country, the first organization to extend the olive branch after the close of the civil war was the American Medical Association. They called their Southern brethren back to the fold and laid the foundation of a restored fraternity; and this great association has placed the keystone in the arch; and let us hope that this work of the last decade of the closing century may be so imbedded in the affections of all the people that future generations, yea, future centuries, may pass over it into history without starting a stone from its place.

I know of no better means of fostering and maintaining a spirit of patriotic devotion to our wonderful republic than the assembling of the people in national associations of various kinds—civil, religious, political and scientific. Let these be the Meccas from which shall emanate a spirit of mutual forbearance, the voice of encouragement, the sentiment of devotion to country, and a fraternity that is a pledge of nationality now, and the hope of its perpetuity.

And let this great organization of ours ever be mindful of the fact that one of her missions is to keep the lamp of Americanism always burn-

ing on her altar; and may its rays permeate every portion of our country, shedding their luster on happy, peaceful, prosperous and contented homes; and may the blessing of the Great Physician ever rest upon us.

The president invited officers and past officers of the association to take seats upon the platform.

Dr. J. B. Murdock, Pittsburg, Pa., moved that a vote of thanks be extended to President Brock for his able and instructive address. Seconded by Dr. J. H. Murphy, St. Paul, Minn., and unanimously carried.

The following committee on nominations was then appointed by the president: Dr. J. H. Manley, N. Y.; Dr. W. B. Blaikslee, Pa.; Dr. J. B. Murphy, Chicago, Ill.; Dr. C. D. Evans, Nebraska; Dr. H. J. Maynard, Cheyenne, Wyo.; Dr. C. K. Cole, Helena, Mont.; Dr. A. A. Thompson, Waxahachie, Tex.

The first report of the executive committee was then read by the secretary, Dr. James M. Dinnen, of Fort Wayne, Ind.

Moved: By Dr. Burton, that the annual dues be fixed at \$5. Carried.

Dr. R. Harvey Reed then moved the adoption of the report as read by the secretary of the executive committee. Carried.

Moved: By Dr. W. A. Ward of Conneaut, Ohio, that such part of the report as referred to the president's address be referred to a committee of three for topical reference. Carried.

Moved: By Dr. C. K. Cole, that adjournment be taken until 2 p. m. Carried.

The convention then adjourned until 2 p. m.

AFTERNOON SESSION.

Pursuant to adjournment the convention re-convened at 2 p. m.

Moved: By Dr. C. B. Stemen, that the action of this association in regard to the adoption of the report of the executive committee be reconsidered. Motion seconded by Dr. J. B. Murphy of Chicago. After a full and free discussion of the

subject, which was participated in by Drs. C. B. Stemen, Fort Wayne, Ind.; J. H. Murphy, St. Paul, Minn.; J. B. Murphy, Chicago, Ill.; Dr. W. B. Outten, St. Louis, Mo.; Dr. Burton, Dr. Bayne, Dr. Rice, Dr. Black of Kansas and Dr. R. Harvey Reed of Ohio, the resolution of Dr. Dougherty of Kansas, read by Dr. Lewis, secretary of the association, from the minutes of meeting of 1892, to publish the proceedings in book form only, was declared, upon being put to a vote, lost by almost unanimous majority; and the report of the executive committee stands adopted, as the sense of the convention.

A paper entitled: "A report of a case of contusion of the back and abdomen followed in five months with intestinal lesions," was then read by Dr. Paul F. Eve, Nashville, Tenn. Discussed by Dr. W. B. Outten of St. Louis. Dr. Robert Burns, Plymouth, N. H., not being present to read his paper, entitled: "Report of a case of fracture of the astragalus," an abstract of same was read by Dr. G. P. Conn, Concord, N. H.

Dr. G. W. Kemper, Muncie, Ind., moved that where persons were not present to discuss papers, those with papers present should be given the preference. Carried.

The special programme on "Injuries of the cord and its envelopes without fracture of the spine," was then taken up and the history read by Dr. George Ross, Richmond, Va. Discussed by Dr. Thomas H. Briggs of Battle Creek, Mich.

"Anatomical landmarks:" By Dr. Jabez N. Jackson, Kansas City, Mo. No discussion.

"Physiology of the spinal cord:" By Dr. A. P. Grinnell, Burlington, Vt. No discussion.

Dr. Elisha Griswold, Shanon, Pa., thought it would be a good plan to appoint delegates to the convention of the International Medical congress, to be held at Rome, Italy, this year. No action was taken, as Dr. Murphy, of Chicago, stated that the meeting would not be held, he understood, on account of the cholera.

Report of the Committee on the Transportation of Dead Bodies.

The committee to whom was referred the subject of the transportation of dead bodies upon railroad trains reported as follows:

Upon investigation we find that many of the state boards of health have formulated rules governing this subject, and that the rules of one board conflict with those of another, especially in the matter of the absolute prohibition of the transportation of bodies dead of certain contagious or infectious diseases. Owing to the fact that no uniform system of rules and forms is in operation, the public health is constantly endangered by the transportation of persons dead of contagious diseases, improperly prepared for such transportation, and relatives and friends in charge of bodies in transit, owing to the same cause, are subjected to all sorts of delays and annoyances.

It is unnecessary to urge the importance of proper precautions in the transportation of dead bodies, or the desirability of securing a uniform system of rules which will secure their transport with the greatest safety to the public and the least annoyance to friends. As the railway companies are deeply interested in this subject, the National Association of Baggage Agents, at a meeting held in 1889, formulated a set of rules and forms and urged their general adoption. The Ohio state board of health, among others, in the autumn of that year promulgated those rules as the law governing this subject in the state of Ohio. Many of the general baggage agents issue a special order to their local baggage agents embodying these rules, and they have been in force upon many of the trunk lines of the country for several years.

As the railroad companies cannot prescribe what contagious diseases shall prohibit the transportation of bodies, or what preparation bodies shall receive for transportation, your committee offer the following resolution as the only action which it appears to them this Association can take in the premises:

Resolved. That the National Association of Railway Surgeons recommends to the state boards of health, or other authorities having jurisdiction in the matter, of all of the states and territories of the United States, the adoption, at as early a date as possible, of the rules and forms adopted by the state board of health of the state of Ohio, in 1889, governing the transportation of dead bodies upon railroad trains.

Resolved. That these resolutions, together with the rules and forms referred to, be published in the transactions of this association.

CHARLES B. FRY, *Chairman.*

The report and resolutions were adopted. The rules of the General Baggage Agents' Association are as follows:

Rules for the Transportation of Dead Bodies.

RULE 1. The transportation of bodies of persons dead of small-pox, Asiatic cholera, leprosy, typhus fever, or yellow fever is absolutely forbidden.

RULE 2. The bodies of those who have died of diphtheria, anthrax, scarlet fever, puerperal fever, typhoid fever, erysipelas, measles and other contagious, infectious or communicable diseases must be wrapped in a sheet thoroughly saturated with a strong solution of bichloride of mercury, in the proportion of one ounce of bichloride of mercury to one gallon of water; and encased in an airtight zinc, tin, copper or lead-lined coffin, or in an airtight iron casket hermetically sealed, and all enclosed in a strong, tight wooden box; or the body must be prepared for shipment by being wrapped in a sheet and disinfected by a solution of bichloride of mercury as above, and placed in a strong coffin or casket, and said coffin or casket placed in a her-

metically sealed (soldered) zinc, copper or tin case, and all enclosed in a strong outside wooden box of material not less than one inch and a half thick.

RULE 3. In cases of contagious, infectious or communicable diseases, the body must not be accompanied by articles which have been exposed to the infection of the disease. And in addition to a permit from board of health or proper health authority, agents will require an affidavit from the shipping undertaker, stating how body has been prepared and kind of coffin or casket used, which must be in conformity with rule 2.

RULE 4. The bodies of persons dead of diseases that are not contagious, infectious or communicable may be received for transportation to local points in same state, when encased in a sound coffin or metallic case, and enclosed in a strong wooden box, securely fastened so that it may be safely handled. But when it is proposed to transport them out of the state to an interstate point—unless the time required for transportation from the initial point to destination does not exceed eighteen hours—they must be encased in an airtight zinc, tin, copper or lead-lined coffin, or an airtight iron casket, or a strong coffin or casket encased in a hermetically sealed (soldered) zinc, copper or tin case, and all enclosed in a strong outside wooden box of material not less than one inch thick. In all cases the outside boxes must be provided with four iron chest handles.

RULE 5. Every dead body must be accompanied by a person in charge who must be provided with a ticket, and also present a full first-class ticket marked "corpse" and a transit permit from the board of health, or proper health authority, giving permission for the removal, and showing name of diseased, age, place of death, cause of death and if of a contagious or infectious nature, the point to which it is to be shipped, medical attendant and name of undertaker.

RULE 6. The transit permit must be made with a stub to be retained by the person issuing it, the original permit must accompany the body to destination, and two coupons; the first coupon to be detached by agent at initial point and sent to general baggage agent, and the second coupon by the last train baggageman. The stub, permit and coupons must be numbered so the one will refer to the other, and on back of permit will be a space for undertaker's affidavit, to be used in case of contagious or infectious diseases as required by rules 2 and 3.

RULE 7. The box containing corpse must be plainly marked with paster, showing name of diseased, place of death, cause of death, the point to which it is to be shipped, number of transit permit issued in connection, and name of person in charge of the remains. There must also be blank spaces at the bottom of paster for station agent at initial point, to fill in the form and number of passage ticket, where from, where to, and route to destination of such ticket.

RULE 8. It is intended that no dead body shall be moved which may be the means of spreading disease; therefore all disinterred bodies, dead from any cause, will be treated as infectious and dangerous to the public health, and will not be accepted for transportation unless said removal has been approved by the state board of health, and the consent of the health authority of the locality to which, the corpse is consigned has been first obtained, and the disinterred remains enclosed in a hermetically sealed (soldered) zinc, tin or copper-lined coffin or box, or box encased in hermetically sealed (soldered) zinc, tin or copper cases.

CERTIFICATE OF UNDERTAKER.		FRONT.		BACK	
		TRANSIT PERMIT		TRANSIT PERMIT	
No.		In the town of County of 18..		State of Date 18..	
Name of deceased 18..		Permission is hereby given to remove the remains of who died at (City or township and county.)		I hereby certify, that the body of named in this transit permit has been prepared by me for transportation by being (Signed) Undertaker.	
Place of death		on the day of 18.. The cause of death being which is a disease, and a transit permit being asked for burial at		County of On this day of A. D. 18.. before me a (Notary public, justice of the peace), in and for the county and state aforesaid, personally appeared to me known, and made oath and says that all of the statements contained in the foregoing are true. Sworn and subscribed to before me this day of A. D. 18.. [SEAL]	
Cause of death		For interment at		Undertaker's affidavit—Infectious or contagious disease.	
Name of person in charge		Name of undertaker. (Signed by)			
Number of transit permit		Name of medical attendant. (Official title.)			
Signed Undertaker.		Name of undertaker. (Signed by)			
..... P. O. Address		Name of medical attendant. (Official title.)			
The above to be filled out by the undertaker and attached to box containing corpse.		Name of medical attendant. (Official title.)			
From to State		Name of medical attendant. (Official title.)			
No. of ticket From No. of ticket		Name of medical attendant. (Official title.)			
From to		Name of medical attendant. (Official title.)			
Via Rd. Via Junction.		Name of medical attendant. (Official title.)			
Via Rd. Via Junction.		Name of medical attendant. (Official title.)			
Via Rd. Via Junction.		Name of medical attendant. (Official title.)			
Via Rd. Via Junction.		Name of medical attendant. (Official title.)			
Signed Station Agent.		Name of medical attendant. (Official title.)			

RULES FOR TRANSPORTATION OF DEAD BODIES.

Moved by Dr. C. B. Frye, Mattoon, Ill., that the matter be referred to a committee of three to take under consideration and recommend a series of forms and rules. Carried. Committee: Drs. C. B. Frye, Mattoon, Ill.; E. R. Lewis, Kansas City, Mo., and C. V. Boarman, Washington, D. C.

EVENING SESSION.

The convention re-assembled at 8 p. m.

Secretary E. R. Lewis read the following report:

Secretary's Report.

There has been expended by the secretary during the past year \$78.55, of which \$59.20 was for postage stamps; the balance of \$18.80 being for printing, express charges, etc., as per bills rendered the treasurer.

Postage stamps to the value of \$18 were required to carry honorary membership certificates, etc., and \$36.80 for correspondence, membership cards, etc., making 1,770 two cent sealed envelopes leaving my office during the year, or about five letters per day for the year, Sundays included. Five dollars was paid for clerical aid.

I have been requested by members to bring before this Association the matter of transporting or shipping corpses having been the victims of contagious or infectious diseases; and the action of this Association on this matter has been requested by the baggage departments of some of the largest companies.

I have received the following communications:

CHICAGO, March 21, 1893.

E. R. LEWIS, M. D.,

Secretary American Railway Surgeons, Kansas City.

DEAR SIR:

We take pleasure in enclosing you a circular relating to our Physicians' Bureau of Service and Information to be operated during the coming Columbian Exposition, together with a copy of a resolution adopted by the Practitioners' Club of this city. Ample accommodations are being provided for the entire medical profession, and we take pleasure in extending through you, an invitation to each and every member of your Association, trusting they will not hesitate to avail themselves of the privileges which we offer without cost to them. We feel that our commodious quarters, large force

of employes and thorough acquaintance with the city, can be of great service to those physicians who visit Chicago during the fair.

We shall endeavor to furnish the very best of accommodations and to render the service in such a manner that no sense of obligation will follow.

We have sent a copy of this letter to the president of your Association and ask if it meets with your approval, that your Society as a body be invited to take advantage of our offer.

Very truly your friends,

CHARLES TRUAX, GREENE & CO.,

By Charles Truax.

At a meeting of the joint committee of the Chicago medical profession on World's Fair entertainment, held at the Sherman House, November, 1892, the establishment of a Bureau of Information and Service was delegated with approval and endorsement to Charles Truax, Greene & Co., the committee reserving to itself the duty of such social entertainment of visiting physicians during the continuance of the exposition as may seem desirable. This action was confirmed at the final meeting of the joint committee, February 25, 1893, and on application of the Practitioner's Club at the South Side Medical Club the matter of social entertainment was delegated to them, with full authority to act in the capacity of entertaining bodies, with the retention of the chairman and its American and foreign secretaries already appointed.

Chairmen—Dr. Charles Warrington Earle,
Dr. Archibald Church.

Secretaries—

American—Dr. George Henry Cleveland, Dr. John C. Cook, Dr. J. C. Culbertson.

British—Dr. Sanger Brown.

German—Dr. F. C. Hotz.

French—Dr. Fernand Henrotin.

Spanish—Dr. E. J. Gardiner.

Italian—Dr. A. Lagario.

Swedish—Dr. K. Sandberg.

Canadian—Dr. R. D. McArthur.

The scope and duties of the above secretaries will be designated in the future.

CHARLES WARRINGTON EARLE,
Chairman.

The special programme on "Injuries to the spinal cord and its envelopes without fracture of the spine" was continued.

Dr. Thomas H. Manley, New York, read a paper entitled "Experimental Research."

Moved by Dr. J. B. Murphy that a vote of thanks be extended to Dr. Manley for his excellent paper, as it involved an enormous amount of work and labor. Carried.

On motion the Association adjourned until 9 a. m., Thursday, June 1.

SECOND DAY—MORNING SESSION.

The Association reassembled at 10 a. m. June 1.

The committees appointed to report on the different sections of President Brock's paper were announced by the secretary as follows:

Relative to a section of the American Medical Association: Dr. W. B. Outten, St. Louis, Mo.; Dr. R. Harvey Reed, Mansfield, Ohio; Dr. W. J. Galbraith, Omaha, Neb.

Relative to inland quarantine: Dr. S. S. Thorne, Toledo, Ohio; Dr. J. M. Montmillin, Ashland, Ky.; Dr. E. F. Yancy, Sedalia, Mo.

Relative to cars for the sick: Dr. G. P. Conn, Concord, N. H.; Dr. W. R. Nugent, Oskaloosa, Iowa; Dr. C. B. Stemen, Ft. Wayne, Ind.

Relative to pan-American congress: Dr. C. W. P. Brock, Richmond, Va.; Dr. C. K. Cole, Helena, Mont.; Dr. J. H. Murphy, St. Paul, Minn.; Dr. J. B. Murdock, Pittsburg, Pa.; Dr. T. H. Manley, New York, N. Y.

Relative to corps and hospital plan: Dr. J. B. Murphy, Chicago, Ill.; Dr. L. O. Rogers, Covington, Va.; Dr. C. M. Drake, Knoxville, Tenn.

Dr. Galbraith, chairman of the committee of arrangements, announced that the Union Pacific Railway Company would furnish Pullman cars to carry all members of this Association and their wives to Denver and return by way of the Hot Springs of South Dakota, over the Burlington & Missouri River railroad, the train to leave Omaha at 9 o'clock on Saturday morning; that if part of the members wished to come back from Denver direct to Omaha one section of the train would be brought to Omaha, while the other would go on to Hot Springs; that on one train dining car service would be given and the other would be accommodated at eating hotels along the line of the Union Pacific road; that stops would be made along the line, especially in Nebraska, at such points as Grand Island, Kearney, North Platte, etc., from fifteen minutes to half an hour, according to the wishes of the Association. That the receipt for dues paid at this session would be sufficient to secure the transportation.

On motion of Dr. Kirkpatrick it was voted that this Association tender a vote of thanks, three cheers and a "tiger" for

the railroads and the Pullman Company, who offer us this magnificent treat. Three cheers and a "tiger" were given.

On motion of Dr. S. S. Riddle of Chippewa Falls, Wis., it was voted that the treasurer purchase an alphabetical register sufficiently large to contain the names of the members of this Association, which shall be placed in the treasurer's office, and all members are requested to register their names, residences, railroad companies and the hotel or house where they are stopping. Carried.

The following addition to Article IV of the Constitution of the National Association of Railway Surgeons was offered as an amendment by Dr. S. S. Riddle, Chippewa Falls, Wis.:

And no person shall be an officer of this Association who does not hold a bona fide appointment as general or other surgeon of some recognized railroad company and in actual service at the time of their election to office.

Seconded by Dr. C. B. Kibler, N. Y. P. & O. R. R., and Dr. W. A. Ward, N. Y. C. & St. L. R. R.

The secretary stated that under the constitution and by-laws this matter must lie over for one year.

Dr. Cole read the following report, which was adopted:

Your committee on that portion of the president's address referring to the pan-American Medical Congress beg leave to report that at a session, held as per announcement, it was by vote agreed to recommend to this Association that immediate and vigorous steps be taken looking to the thorough organization of the section in the congress of "railway surgery," and to this end we urge that such members here present as can do so send in their names and the titles of papers which they are willing to read, such names and titles to be sent to the chairman, Dr. C. W. P. Brock, Richmond, Va.

Signed: C. K. Cole, chairman; C. W. P. Brock, J. H. Murphy, J. B. Murdock, T. H. Manley, committee.

Dr. Reed moved that no person be accepted as honorary member of this Association except his name, address and title as to his standing in the railroad company be handed in in writing, properly signed by the party recommending the same to the chairman of the executive committee, and that such committee pass upon these and submit the said list, with their recommendation, to the Association for approval, and that only such applicants should be elected honorary members. Carried.

Treasurer's Annual Report.

The treasurer, Dr. R. Harvey Reed, submitted the following report for the year commencing June 1, 1892, and ending May 31, 1893, which was referred to the executive committee:

CENSUS OF MEMBERS.

Dropped for nonpayment of dues as per constitution.....	44
Deceased members.....	12
Members who owe for 1892 and have refused to pay.....	123
Members discontinued at their own request without explanation.....	43
Members who have left the service and were discontinued at their own request.....	14
Members who were sick and could not pay.....	3
Dropped for unwarranted, unprofessional and ungentlemanly conduct.....	1
Total exemption from the roll for all causes.....	240
Members in good standing who have paid up their dues in full to June 1, 1893.....	1,566

COLLECTIONS.

At the close of the last fiscal year we had a total enrollment of members in good standing of 1,236, many of whom renewed their dues while attending the meeting at Old Point Comfort. Those who did not, however, were promptly notified the first of July, the first of August and the first of September, at which time they were informed that those who did not pay on or before the first of October would be drawn on through the bank. I am glad to say, however, that with each notification a large number of members responded promptly.

On the first of October I drew on the balance who were in arrears and received a large number of dues from members who owed for both 1892 as well as 1891. Those however, who were in arrears for 1891 and 1892, and did not honor the drafts, were promptly notified in accordance with the constitution that they had been dropped from the roll of members for non-payment of dues. Those who owed for 1892 and refused to honor the draft were simply registered on the roll as having "refused to pay."

Through the courtesy of Mr. H. P. Robinson, president of The Railway Age company, the journal was continued for several weeks after the beginning of the fiscal year at his own risk and expense in hopes that the members would pay their dues for the present year without further notification, but after a certain time those members who failed to pay, after being duly notified, were dropped from the mailing list of The Railway Age; or in other words, only those were furnished with The Railway Age and the fifth volume of transactions who paid up their dues in full for the fiscal year, so that neither the association nor the publishing company would lose by having furnished The Age or transactions to members who were in arrears.

FINANCES.

As published in The Railway Age monthly, the following table shows the amount of cash received each month during the year:

Cash received for dues at the fifth annual meeting.....	\$2216.00
Collections for June, 1892.....	320.00
" " July, " 	960.00
" " August, " 	176.00
" " September, " 	164.00
" " October, " 	554.00
" " November, " 	91.00
" " December, " 	436.00
" " January, 1893.....	567.00
" " February, " 	215.00
" " March, " 	175.00
" " April, " 	225.00
" " May, " 	188.00
Total amount of cash received.....	\$6,287.00

This sum was paid by 1,566 members. You will observe that after the exemption of members from the roll for all causes there is left a total membership in good standing of 1,566 members, equal to an increase of 572 members during the year; and after deducting 240 dropped from the roll for all purposes there is a net increase of members in good standing over the number of last year of 332.

Through the courtesy of Mr. Harry P. Robinson, president and manager of The Railway Age and Northwestern Railroader, a circular letter was sent to the management of the 929 railroads in the United States, Canada and Mexico, making inquiries as to the number of surgeons in their employ and asking them to furnish a list of the same. Out of the 929 railroads, 198 answered the circular letter. Of these 49 have no surgeons at all in their employ and 149 have a surgical service of some kind in which they employ 4,130 surgeons.

A circular letter was prepared by your treasurer setting forth the objects of the National Association of Railway Surgeons as well as giving the programme of the fifth annual meeting, together with a copy of the preliminary programme for the present meeting, and inviting the recipients to join the association. This letter was only intended to be sent to those who were not members of our association and consequently it necessitated checking over 4,000 or more surgeons to ascertain who were members and who were not. After obtaining these facts these letters were mailed to all those who were not members, from whom we received a very large number of favorable replies, which have swelled our membership in good standing to 1,566 and show that there are yet over 2,500 surgeons in the United States, Canada and Mexico who are not members of our association, saying nothing of those railroad companies which did not respond to Mr. Robinson's circular letter, and which may possibly have a surgical service of some kind. Thus, allowing a fair estimate, would probably swell the total number of railway surgeons in the United States to approximately 6,000.

DIVISION OF ACCOUNTS.

According to the instructions of the executive committee and confirmed by the association at the fifth annual meeting held at Old Point Comfort, the entire receipts were divided into two accounts, namely, the journal account and the expense account. Seven-eighths of all the dues for the fiscal year of 1892 were placed to the credit of the journal account, while one-eighth, together with all arrearages, were placed to the credit of the expense account.

JOURNAL ACCOUNTS.

There has been charged to the journal account during the year \$5,481. This sum has been paid to The Railway Age company, which balanced the journal account.

The Railway Age company, according to its contract, furnished 1,566 members with The Railway Age and Northwestern Railroader and also a bound volume of the transactions of the fifth annual meeting, containing 232 pages of closely printed matter. It also furnished all the necessary illustrations for these proceedings and in addition published a revised roll of active members up to March 1, 1893. These proceedings have been classified and chaptered so that any member who desires to look up any particular subject will find it under the table of contents, of which there are thirteen chapters, containing from one to seven papers each on important railroad subjects. The publishers have also furnished to the medical press throughout this country a weekly exchange as well as a copy of these transactions, and many of the latter to the management of the various railroads throughout the United States, Canada and Mexico, for all of which they have been paid \$5,481, which is in full of their account to date.

EXPENSE ACCOUNT.

You will observe by the statement herewith attached that there was a balance in the hands of the treasurer of \$345.16 from last year's account to the credit of the expense account, which added to the \$806 received by the expense account during the present year, makes a total of \$1,151.16. There was paid during the present year for sundry expenses, an itemized account of which will be found in the treasurer's book, and in the receipted bills on file with the treasurer, counter-checked by the vouchers issued by the secretary, the sum of \$1,059.09; which leaves a balance in the hands of your treasurer to the credit of the association for the coming year of \$92.07.

STATIONERY AND SUPPLIES.

Your treasurer supplied himself with two blank receipt books with stubs numbered from one to 2,000. The receipts and stubs were both numbered to correspond, in order that the record kept by the treasurer would correspond with the receipt sent to each member. In addition to this the application blanks, together with the membership certificates, were forwarded daily to the secretary for record on his book.

The letterheads used by the officers were procured of a lithographic firm as in former years, and each officer was supplied with the necessary stationery to transact the business of his office. To this should be added the membership certificates for each member which were procured of the same firm.

Owing to the large number of honorary members elected last year it became necessary for us to procure an additional number of 100 of these certificates, which, with a balance of 160 remaining from last year, made a total of 260 membership certificates, of which there are now 117 in the hands of the treasurer.

We were obliged to secure several thousand notification blanks which were used in calling the member's attention to their dues and arrearages, and, as it was necessary to repeat these notices several times, it required a larger number of these blanks than would have been necessary had all our members been as prompt in paying their dues as the majority were.

It was also necessary to secure between five and six thousand four-page circulars, inviting those who were not members to join the association. In each instance where these invitation circulars were sent out, they were accompanied by a copy of the constitution and by-laws and an application blank and envelope. Several hundred copies of the special programme were furnished Dr. George Chaffee and Dr. F. K. Ainsworth, to be sent by them with their circular letter to the management of the various leading railroads of the country in search of important statistics for their papers.

Having run out of the constitution and by-laws we were obliged to get several thousand more printed in order to supply each surgeon to whom we sent invitations, as well as to those who made inquiry in reference to joining the association.

THE POLICY OF THE EXECUTIVE COMMITTEE.

After consultation with the executive committee subsequent to the fifth annual meeting it was decided to continue the same policy adopted after the Buffalo meeting, viz.: the cash plan, which is considered the only safe and reliable method of conducting the financial business of an association that has representatives in nearly every state and territory, besides the Dominion of Canada and the Republic of Mexico.

GENERAL REMARKS.

Whilst with the rapid growth of our association the work has been materially increased in the treasurer's office, yet the annoyance we had to contend with last year in settling up old accounts did not figure in this year's work, which, in that respect, it was lessened, showing that the policy that the executive committee has recommended and the association adopted for the last two years in succession, is the proper one and one that should be made perpetual.

We, as an association of railway surgeons, representing large business corporations, who transact their business on strictly business principles, should adopt and maintain a business policy. In all our business relations everything should be done in a systematic manner and in such a way that it can be traced from one office to another and from the members to the officers and vice versa. This, of course, requires extra work and extra time and trouble, but it is the only way by which we can save ourselves from the difficulties which have involved other national associations in conducting the financial part of their business.

You will please remember that at the annual meeting last year we had 1,236 paid up members, and that during the fiscal year just closed we have

increased our membership over 26 per cent, besides making up for the 240 who fell by the wayside, and that after paying all expenses for conducting the work (which I desire to suggest has become a real matter of work which requires my personal attention practically a large part of every day in the year, except Sunday, and often then I am tempted to violate the Commandments in order to keep up with my work) there is still a balance left in the hands of your treasurer for the next year amounting to \$92.07.

RECOMMENDATIONS.

I would suggest that each member study carefully the interest of the association as a whole, and bear in mind that the larger the association becomes the more responsibility is placed on him as well as his officers in order to manage it satisfactorily. It is utterly impossible to conduct an association the size of this one to the satisfaction of every one, but it is the duty of your officers, no matter what position they may fill, to endeavor to do their share of the work in such a manner as will result in the greatest good to the greatest number of members.

In conclusion I would recommend as I did last year:

First—That the cash policy be not only adopted, but be continued, and that the membership certificates be issued only to those members who pay their dues in full to June, 1894.

Second—That no publications be sent to the members who are in arrears for their dues, except at the risk of the publishers, and that it be left with the publishers entirely as to how long they may choose to furnish their publication to such members after the beginning of the fiscal year, before they are dropped from the mailing list.

Third—That an annual membership certificate be issued in the same manner and style as last year, except that they be numbered, so that no two members will hold the same number of certificate. In addition to this I would recommend that each new honorary member be issued a certificate notifying him of his election as soon as practicable after the annual meeting, and that the secretary be instructed to deliver these, accompanied by an explanation as to why such certificate was issued.

Fourth—That the treasurer be instructed to continue to render weekly reports of the names and addresses of the new members and make a monthly statement the first of every month of the amount of cash received for the month just past; provided, the publication adopted for the coming year is of such a character as to admit of these reports being made in this manner.

Fifth—That the secretary be, and is hereby instructed to have his seal so repaired as to enable him to place it on the honorary membership certificates, right side up, and that he be instructed to place a neat bronze wafer on each certificate under the seal placed thereon.

Condensed Statement of the Association's Finance.

TREASURER'S ACCOUNT.

1893.

May 31. To total amount of cash received for the year	\$6,287.00
By journal account	5,841.00
By expense account	1,151.16

JOURNAL ACCOUNT.

To cash received from treasurer's account..... \$5,481.00
 By RAILWAY AGE COMPANY as per contract for publishing journals and transactions..... 5,481.00

RAILWAY AGE ACCOUNT.

By 1,566 journals and transactions.....\$5,481.00
 To cash in full to date..... 5,481.00

EXPENSE ACCOUNT.

To cash on hand at beginning of year.....\$ 345.16
 To cash received from treasurer's account..... 806.00
 By sundry expenses for year..... 1,059.09
 Balance in hand of treasurer..... 92.07

Appendix to Treasurer's Report.

TABLE OF MEMBERS BY STATES.

Alabama.....	16	Maryland.....	10	Rhode Island.....	1
Arkansas.....	25	Massachusetts.....	3	South Carolina.....	17
Arizona.....	3	Michigan.....	67	South Dakota.....	23
California.....	16	Minnesota.....	55	Tennessee.....	11
Colorado.....	33	Mississippi.....	26	Texas.....	67
Connecticut.....	2	Missouri.....	103	Vermont.....	2
Dist. of Columbia...	2	Montana.....	10	Virginia.....	38
Delaware.....	0	Nebraska.....	62	Washington.....	19
Florida.....	13	Nevada.....	1	West Virginia.....	33
Georgia.....	23	New Mexico.....	2	Wisconsin.....	63
Idaho.....	4	New Hampshire....	6	Utah.....	7
Indian Territory....	6	New Jersey.....	9	Wyoming.....	6
Illinois.....	117	New York.....	50	Canada.....	15
Indiana.....	76	North Carolina....	20	Mexico.....	10
Iowa.....	116	North Dakota.....	12	British Columbia...	1
Kansas.....	90	Oklahoma.....	1		
Kentucky.....	15	Ohio.....	113	Total.....	1,566
Louisiana.....	6	Oregon.....	10		
Maine.....	0	Pennsylvania.....	131		

All of which is very respectfully submitted,

R. HARVEY REED, *Treasurer.*

Dr. E. R. Lewis of Kansas City read a paper entitled "The National Association of Railroad Surgeons Not a Trade Union, but a Philanthropic, Scientific Organization." Discussed by Dr. William Elliot, Savannah, Ga.

The following resolution was handed to the Secretary and read:

Resolved, That section V of the by-laws of this association be amended by striking out all of said Section and substituting therefor the following:

"The nominating committee shall consist of one member from each state, territory or province represented at each annual meeting of the association; to be selected by those present from each state, territory or province, each name so selected to be handed to the president in time for him to announce at the close of the afternoon session of the first day. It shall be the duty of this committee to report to the association at the opening of the afternoon session on the second day a list of nominees to fill the offices and standing committees provided for in the constitution and by-laws; also to nominate the place of meeting for the next annual session."

Signed: W. A. Ward, N. Y. C. & St. L. R. R., Conneaut, Ohio.

Seconded by S. S. Riddle, C. St. P. M. & O. R. R., Chippewa Falls, Wis.; J. H. Rothwell, C. M. & St. P. Ry., Liberty, Mo.

After some discussion of this question, Dr. Reed moved to lay the resolution on the table. Carried.

Dr. John Van Dyne then read a paper entitled "Amputations," which was discussed by Dr. John N. Warren, Sioux City, Iowa; Dr. W. P. King, Kansas City; Dr. J. G. Buchanan, of Alleghany City, Pa.; Dr. A. S. Von Mansfelde, Ashland, Neb.; Dr. H. J. Maynard, Cheyenne, Wyo., and Dr. J. B. Murdock, Pittsburg, Pa.

Adjournment was taken until 2 p. m.

SECOND DAY.—AFTERNOON SESSION.

The association reassembled at 2 p. m.

On motion a committee of three upon resolutions was appointed, consisting of Dr. R. S. Harnden, Waverly, N. Y.; Dr. D. F. Stuart, Houston, Tex., and Dr. S. S. Thorne, of Toledo, Ohio.

The following resolution was offered by Dr. J. H. Owings, Deer Lodge, Mont.:

Whereas, Dr. J. B. Murphy has entertained a number of members of this association with an explanation of his "anastomosis button," therefore be it

Resolved, That, in view of the great interest manifested, Dr. Murphy be requested to make an exemplification of its workings upon the living subject before this association.

It was agreed that Dr. Murphy should make the demonstration upon Friday, June 2.

The paper of Dr. S. C. Benedict entitled "Pathology and pathological anatomy" in the special programme on "Injuries to the cord and its envelopes without fracture of the spine" was then read by Dr. Jabez N. Jackson and discussed by Dr. J. B. Murphy

ing on her altar; and may its rays permeate every portion of our country, shedding their luster on happy, peaceful, prosperous and contented homes; and may the blessing of the Great Physician ever rest upon us.

The president invited officers and past officers of the association to take seats upon the platform.

Dr. J. B. Murdock, Pittsburg, Pa., moved that a vote of thanks be extended to President Brock for his able and instructive address. Seconded by Dr. J. H. Murphy, St. Paul, Minn., and unanimously carried.

The following committee on nominations was then appointed by the president: Dr. J. H. Manley, N. Y.; Dr. W. B. Blaklee, Pa.; Dr. J. B. Murphy, Chicago, Ill.; Dr. C. D. Evans, Nebraska; Dr. H. J. Maynard, Cheyenne, Wyo.; Dr. C. K. Cole, Helena, Mont.; Dr. A. A. Thompson, Waxahachie, Tex.

The first report of the executive committee was then read by the secretary, Dr. James M. Dinnen, of Fort Wayne, Ind.

Moved: By Dr. Burton, that the annual dues be fixed at \$5. Carried.

Dr. R. Harvey Reed then moved the adoption of the report as read by the secretary of the executive committee. Carried.

Moved: By Dr. W. A. Ward of Conneaut, Ohio, that such part of the report as referred to the president's address be referred to a committee of three for topical reference. Carried.

Moved: By Dr. C. K. Cole, that adjournment be taken until 2 p. m. Carried.

The convention then adjourned until 2 p. m.

AFTERNOON SESSION.

Pursuant to adjournment the convention re-convened at 2 p. m.

Moved: By Dr. C. B. Stemen, that the action of this association in regard to the adoption of the report of the executive committee be reconsidered. Motion seconded by Dr. J. B. Murphy of Chicago. After a full and free discussion of the

subject, which was participated in by Drs. C. B. Stemen, Fort Wayne, Ind.; J. H. Murphy, St. Paul, Minn.; J. B. Murphy, Chicago, Ill.; Dr. W. B. Outten, St. Louis, Mo.; Dr. Burton, Dr. Bayne, Dr. Rice, Dr. Black of Kansas and Dr. R. Harvey Reed of Ohio, the resolution of Dr. Dougherty of Kansas, read by Dr. Lewis, secretary of the association, from the minutes of meeting of 1892, to publish the proceedings in book form only, was declared, upon being put to a vote, lost by almost unanimous majority; and the report of the executive committee stands adopted, as the sense of the convention.

A paper entitled: "A report of a case of contusion of the back and abdomen followed in five months with intestinal lesions," was then read by Dr. Paul F. Eve, Nashville, Tenn. Discussed by Dr. W. B. Outten of St. Louis. Dr. Robert Burns, Plymouth, N. H., not being present to read his paper, entitled: "Report of a case of fracture of the astragalus," an abstract of same was read by Dr. G. P. Conn, Concord, N. H.

Dr. G. W. Kemper, Muncie, Ind., moved that where persons were not present to discuss papers, those with papers present should be given the preference. Carried.

The special programme on "Injuries of the cord and its envelopes without fracture of the spine," was then taken up and the history read by Dr. George Ross, Richmond, Va. Discussed by Dr. Thomas H. Briggs of Battle Creek, Mich.

"Anatomical landmarks:" By Dr. Jabez N. Jackson, Kansas City, Mo. No discussion.

"Physiology of the spinal cord:" By Dr. A. P. Grinnell, Burlington, Vt. No discussion.

Dr. Elisha Griswold, Shanon, Pa., thought it would be a good plan to appoint delegates to the convention of the International Medical congress, to be held at Rome, Italy, this year. No action was taken, as Dr. Murphy, of Chicago, stated that the meeting would not be held, he understood, on account of the cholera.

Report of the Committee on the Transportation of Dead Bodies.

The committee to whom was referred the subject of the transportation of dead bodies upon railroad trains reported as follows:

The committee on resolutions then reported as follows:

"Your committee on resolutions beg leave to offer the following:

WHEREAS, The railroads have taken a greater interest in our association this year than at any time heretofore, both east and west, therefore be it,

1. *Resolved*, That this association extend hearty thanks to all railroad managers who have extended free transportation for the purpose of enabling the members of the association to attend the sixth annual meeting, now about to be closed; and especially do we wish to thank the management of the Union Pacific and F. E. & M. V. R. R. companies for the elegant and enjoyable arrangements they have voluntarily made for the free excursions to Denver and the Hot Springs of South Dakota.

2. *Resolved*, That we extend our thanks to the press of Omaha for the carefully prepared and full reports of the proceedings of the numerous sessions held during this meeting.

3. *Resolved*, That the thanks of this association be extended to the hotels of the city for their hospitable entertainment of the members during their stay in the city; and also to the citizens for their hospitality and kindness during our sojourn among them.

4. *Resolved*, That this association extend a vote of thanks to Dr. W. J. Galbraith for his untiring energy and successful efforts to make this meeting one of the greatest in the history of the association.

5. *Resolved*, That President Brock and his staff of officers and committees be given a vote of thanks for their united efforts in behalf of the association and the untiring manner in which they have served its members during the past year.

Signed:

R. S. HARNDON, Chairman.
S. S. THORNE,
D. F. STUART,
Committee."

Adopted unanimously.

It was then voted that the above resolutions be printed in circular form and copy be mailed to each person to whom the resolutions refer.

President Brock thanked the members of the association for the vote of thanks tendered to himself and staff.

The second report of the executive committee was read by Dr. James N. Dinnen, secretary, as follows:

The committee reported that they had received a proposition from THE RAILWAY AGE AND NORTHWESTERN RAILROADER, offering \$150 for the best essay read at the 1894 meeting of the association.

Also that the report of treasurer has been examined and found correct.

Dr. Wilson, chairman of the executive committee, stated that said committee thought it best to divide the prize offered into three parts, viz: first prize \$100, second prize \$50 and honorable mention for third.

Mr. J. W. Eddy, of New York, then moved that the resolution of Dr. F. J. Patchin, of Nebraska, be taken from the table in order that Dr. R. Harvey Reed might be cleared, if entitled to be cleared, of the allegations therein contained; he said that the resolution left a bad impression, and that he knew to his own personal knowledge that it was false.

The motion was seconded by R. Harvey Reed.

Secretary Lewis read the resolution of Dr. Patchin, which was, on motion, referred to a committee of five, composed of Drs. Murdock, Outten, Murphy, of St. Paul, Stemen and Lewis, to examine and report to the convention in the afternoon.

The report of the nominating committee was read by Dr. C. K. Cole, chairman, as follows:

Your nominating committee beg leave to submit for your consideration the following report and recommendation:

For president, Dr. W. J. Galbraith.

For first vice president, Dr. E. R. Lewis.

For second vice president, Dr. Thomas H. Manley.

For third vice president, Dr. E. F. Yancey.

For fourth vice president, Dr. D. F. Stuart.

For fifth vice president, Dr. E. A. McGannon.

For sixth vice president, Dr. E. G. Cochran.

For seventh vice president, Dr. W. R. Blaislee.

For secretary, Dr. J. M. Dinnen.

For assistant secretary, Dr. J. H. Ford.

For treasurer, Dr. R. Harvey Reed.

For members of executive committee, Dr. A. J. Mullen, Jr., to fill unexpired term of Dr. J. M. Dinnen; Dr. J. B. Murphy, Dr. A. A. Thompson, Dr. C. K. Cole.

For chairman of transportation committee, Dr. W. B. Outten. (Remainder of the committee to be filled by the chairman.)

For chairman of the committee of arrangements, Dr. C. A. Wilkinson. (Remainder of committee to be filled by the chairman.)

Next place of meeting, Galveston, Tex.

The following list of names proposed for honorary membership in this association and referred to the committee on nominations are recommended for election: [See Chapter IV for correct list.]

We recommend that the date of the next annual meeting be decided and officially announced by the executive committee.

We recommend that this association extend a vote of thanks to Dr. E. R. Lewis, of Kansas City, who has, since the Kansas City meeting, so faithfully and efficiently served us as secretary. It is our judgment that the sound basis of prosperity of this association is, in a large measure, due to his zealous and untiring efforts.

It is also recommended that Mr. Harry P. Robinson of THE RAILWAY AGE be made an associate member of the committee on transportation and that the association extend to him a vote of thanks for his efficient services in the past.

Dr. C. K. Cole moved that the names for honorary membership be referred to the executive committee for consideration and recommendation. Carried.

Dr. Murphy, of St. Paul, then moved the adoption of the report of the committee on nominations.

Dr. Cole explained that the committee, at its last meeting, had decided to recommend Galveston, Tex., as the next place of meeting; that subsequently objections were urged against that city, which might have some weight. It was then decided that inasmuch as it was impossible to reconvene and consider the matter the committee would recommend Galveston and make a favorable statement in connection with it, in consideration of the fact that the committee had the entire list of cities recommended to them for their consideration in the event of their desiring to change the place of meeting from Galveston. Dr. Cole then suggested that Dr. Murphy's motion exclude the place of meeting.

Dr. Murphy accepted the suggestion and moved that the report of the nominating committee be adopted except as to the place of meeting. Carried.

On motion of Dr. Ward, of Ohio, the secretary was instructed to cast the ballot of the association for the names mentioned in the report of officers of the association.

The president then declared the members nominated duly elected, and presented President-Elect Dr. W. J. Galbraith, chief surgeon of the Union Pacific system, Omaha, Neb., who was received with great applause.

Dr. C. K. Cole moved that the report of the committee with reference to Galveston, Tex., as the next place of meeting be adopted. Carried.

The report of the committee on quarantine was read by Dr. S. S. Thorne, of Toledo, Ohio, as follows:

1. "As quarantine is for the general good, this quarantine should conform to the general law.

2. Being a public service, should be done at public expense, and not chargeable to railroads.

3. Railroad surgeons are the best agents, because, from their familiarity with the service, are less liable to interfere with travel.

Railroads should supervise fumigation, disinfection and care for affected travel.

Signed:

S. S. THORNE, Ohio.

E. F. YANCEY, Mo.

J. M. MONTMOLLIN, Ky.

Committee."

The report was adopted.

The vote of the association was then taken on the recommendation of the executive committee with regard to dividing the prize offered by Mr. Harry P. Robinson, president of THE

RAILWAY AGE Co., into three viz: First prize, \$100; second prize, \$50; third prize, honorable mention.

This division was unanimously adopted.

Dr. D. S. Fairchild, Ames, Iowa, read a paper entitled: "A case of injury to the bladder and rectum." Discussed by Dr. H. H. Middlecamp, Mo., Dr. Elisha Griswold, Pa., Dr. J. B. Murdock, Pa., Dr. Newton, Dr. Jesse Hawes, Colo. and Dr. M. W. O'Brien, Va.

Dr. J. A. White, Richmond, Va., read a paper entitled: "The grave importance of too early specific treatment in most eye injuries." Discussed by Drs. Curry and Wilson.

A paper entitled: "Responsibility of the surgeon in suits for damages against railway companies," was then read by Dr. C. M. Woodward, Tecumseh, Mich.

An adjournment was taken until 2 p. m.

THIRD DAY—AFTERNOON SESSION.

Dr. D. G. Munell, of Paducah, Ky., said:

"I wish to offer a resolution of thanks to Dr. Murphy, of Chicago, for the skillful clinical demonstrations of the uses of his 'anastomatic button,' for operations upon the intestine, which makes these difficult operations so plain of performance, so perfect of adjustment and safe in results, the most wonderful application of mechanics to surgery of this decade. This button, in my judgment, is, to intestinal surgery, what the reaper is to agriculture, the steam engine to traffic, or the telescope to astronomy. It simply puts into the hands of all surgeons one more means of saving life—the high mission of our calling. Had Chicago never erected her towering buildings or spread to the gaze of a wondering world her White City, she would have been known to the roll of ages, for without doubt the milestones of time will be marked by the lives of those saved by the grand and perfect little device of a member of this association from Chicago, Dr. J. B. Murphy; and I move you, sir, that this association thank Dr. Murphy by a rising vote for his demonstration of this, his great gift to the world."

Carried unanimously, all present rising.

Moved by Dr. Elisha Griswold, of Pennsylvania, that the paper of Clarke Bell, Esq., entitled, "Railway surgery in law and medicine," be referred to the publication committee. Carried.

Paper by Dr. J. T. Field, chief surgeon Ft. W. & R. T. Ry., Fort Worth, Tex., entitled, "Bandage for fractured clavicle,"

(with two photographs) was also referred to the committee on publication.

Moved by Dr. T. H. Manley, New York, that inasmuch as it was impossible for Dr. George Chaffee of Brooklyn, N. Y., to be present to read his paper on the "Clinical report of injuries to the cord without fracture to the spine," be referred to the publication committee. Carried.

Dr. Joshua Chitwood, local surgeon of the C. C. C. & St. L. Ry., Connersville, Ind., then read a voluntary paper, written by him, entitled, "Superheated steam as applied to ships and railroad coaches as a germicide."

Discussion upon this important subject was participated in by Dr. E. R. Lewis, Kan., Dr. T. H. Manley, N. Y., Dr. S. S. Thorne, of Ohio, Dr. J. B. Murphy, of Chicago.

Dr. E. R. Lewis offered the following:

"Resolved, That this association endorse the action taken last year by the New York board of health and compliment the efficiency with which Dr. J. W. Jenkins, quarantine officer at the port of New York, carried out the thorough and effective quarantine last year." Seconded by Dr. J. H. Murphy, of St. Paul.

Carried unanimously.

The committee appointed to examine the treasurer's books, accounts, etc., vouchers and receipts reported as follows:

"Your select committee, to whom was referred the matter of reporting on the treasurer's books, report that in the limited time afforded them they have so far as possible satisfied themselves that the work of the executive committee in examining the treasurer's books was well and properly done; that the objection of those members who have paid one year's dues for a membership for only a fraction of a year is not well founded or possible to meet under our existing laws, and further that the plan of bookkeeping in use by the treasurer is correct. Under our contract with THE RAILWAY AGE we have been obliged to pay for the whole year when journals for only a portion of the year have been furnished.

We respectfully recommend to the publication committee that in the future a contract be made so that our treasurer will be obliged to pay only for the journals furnished."

Signed:

J. B. MURDOCK, Pa.
W. B. OUTTEN, Mo.
J. H. MURPHY, Minn.
C. B. STEMEN, Ind.
E. R. LEWIS, (Absent) Kan.
Committee.

The above report was adopted.

Dr. Thorne moved that "the United States government take charge of all quarantine matters, and that this association make it known to the 'powers that be' that we desire it left in that way."

Dr. Manley hoped the members would hesitate before taking this action; that the state should be left in control of the matter.

Dr. Rogers spoke in support of Dr. Thorne's resolution.

Dr. Porter, of Indiana, strongly urged placing the matter in the hands of the national government.

Dr. Newton, New Jersey, spoke in favor of uniformity in the matter of quarantine laws, and believed the United States government was the proper channel through which quarantine matters should be directed.

The motion of Dr. S. S. Thorne was then carried.

The secretary read the following resolution offered by H. E. Bone, M. D., (Iowa):

"Resolved, That all discussion of a political nature be forever prohibited in this association."

Seconded and carried unanimously.

The following resolution was read:

"Pursuant to a call the ladies accompanying the members of this association met in the parlors of the Millard hotel and passed the following resolutions:

WHEREAS, The management of the railroads have extended to us the courtesies of free transportation, and thus enabled us to enjoy the privileges of the sixth annual meeting of the National Association of Railway Surgeons, including the excursion to Denver and Hot Springs; therefore be it

Resolved, That we extend our thanks to the managements of those railroads for these courtesies and privileges so freely given."

Signed:

MRS. C. W. P. BROCK (Va.),
Chairman.
MRS. J. H. FORD (Ind.),
Secretary.
MRS. J. H. MURPHY (Minn.),
MRS. B. F. WILSON, (Mo.)
MRS. W. H. LYNN (Neb.),
MRS. A. A. T. CUNNINGHAM (S. C.),
MRS. D. G. MUNELL (Ky.),
MRS. R. HARVEY REED (Ohio),
Committee.

A motion was made that no exhibits should be allowed to be made in the hall where this association holds its future meetings; or, if allowed to exhibit in the building, it shall be outside of the room in which the convention is assembled, and that the doors leading therefrom shall be kept closed during the sessions of this association, thus obviating in the future a repetition of the great annoyance experienced at this session by members occupying seats in the rear part of the hall, on account of persons examining exhibits and holding loud conversation in regard thereto. Carried.

The following resolution was then read:

"Resolved, By the National Association of Railway Surgeons that a committee of five (5) or more be appointed by the president to confer with the American Medical Association to adopt means necessary to keep out cholera or any contagious or infectious diseases from the limits of the United States."

Signed:

VAN B. THORNTON,
Local Surgeon H. & T. C. Ry., Tex.

Adopted.

The president appointed as such committee Dr. C. K. Cole, Dr. J. H. Murphy, Dr. W. J. Galbraith, Dr. O'Daniel and Dr. Jesse Hawes.

Dr. Layton, Leon, Iowa, read the following resolution:

"Resolved, That we, as members of the National Association of Railway Surgeons, suggest to the proper officers of the various railroads to place upon all passenger trains in as secure a place and condition as possible, a case containing the necessary instruments, bandages, splints, applications and medicines, generally required in a case of injury. And also that the conductors be instructed in the use of the hypodermic syringe, tourniquet, bandages, and the administration of such simple medicines as are deemed necessary in case of an accident."

A motion was made to lay this resolution on the table.
Carried.

Dr. H. H. Middlecamp offered the following motion:

"That we, as the National Association of Railway Surgeons, request congress to create a secretary of health or cabinet health officer, and make him equal with any officer in the president's cabinet. Let him be the supreme health officer in the United States."

Seconded. A vote being taken the motion was declared lost.

Dr. McCrea of Council Bluffs moved a reconsideration of the question and called for a division of the house.

The president sustained the point of order raised by a member.

Dr. McCrea appealed from the decision of the chair.

On an appeal to the house the decision of the chair was sustained.

Dr. Holliday, of Illinois, moved that the management of every railroad be requested to keep a stretcher in every depot for use in cases of injury.

Dr. Murphy, of Minnesota, hoped this motion would not prevail, and moved that it be laid upon the table. Carried.

President C. W. P. Brock then entrusted the affairs of the association to the keeping of President-Elect Dr. W. J. Galbraith, of Omaha, Neb.

President-Elect Galbraith, in a few well-chosen and timely remarks, accepted the trust, and a motion to adjourn having been carried, declared the sixth annual meeting of the National Association of Railway Surgeons adjourned; the seventh annual meeting to be held at Galveston, Tex., date to be fixed by the executive committee.

CHAPTER II.

Injuries of the Cord and Its Envelopes without Fracture of the Spine.—History.

[By SURGEON GEO. ROSS, Richmond, Va.]

In the development of the embryo out of which shall be formed the animal "Man," the vertebral column is the first to take form and substance; and, around it, as a rallying point, are gathered in appointed succession the varied and marvelous structures with which he is empowered to perform the multifarious duties of life. Its integrity as a unit is absolutely essential to his healthful and happy existence. How important, therefore, is its preservation intact, and how necessary is a clear and intelligent appreciation of the intimate and interdependent relations existing between all of its component parts. Within this osseous framework, a slender, cylindrical organ, the spinal cord, hangs loosely depended from, and is an integral part of the brain. At its lower limit in the sacrum a mere nervous leash marks its existence. A single ounce, plus, is its weight.

Three (3) membranes lend it their shielding and preserving presence. The "dura mater," strong and fibrous, attached to the margin of the "foramen magnum" above, and fusing its walls at the second sacral vertebra below, is securely yet loosely, held in place by twenty-two (22) lateral ligaments.

The "arachnoid," thin, serous and semi-transparent, lying loosely over the cord and roots, is intimately in communication by connective tissue filaments with the sub-lying "pia mater," which is the immediate vascular investment of the cord.

Between each membrane nature has wisely arranged a cavity into which flows in ever varying quantity the "cerebro-spinal fluid," which like a universal hydraulic cushion, supplements the natural moveability of the cord of about a half inch, and serves to shield it from accident. That a wise builder should have deemed necessary the careful guarding of so delicately constructed and so alternately an organ from every avenue of danger's approach, seems not unnatural; and that most painstaking and abundant protection was provided, the dissector's knife has not failed to

yield the most convincing proof. Hence it was that until these latter years the Medical World had little occasion to investigate the results of injuries befalling it. But now, the extent to which its injury is possible—save in the more violent and immediately destructive accidents, and the results accruing therefrom—has grown to be a subject of widely differing professional opinion; and it is in the effort to aid in the clearing up of difficulties, and lending a helping hand to those engaged in this most important branch of the Science of Surgery that we to-day inaugurate the discussion of the subject of "Injuries to the Spinal Cord and Its Envelopes, Without Fracture."

As introductory to the discussion, I adopt the words of Montaigne "*Je raconte, je ne juge pas*," and proceed to a necessarily brief resume of so young a subject. Littre, in 1705, published a series of observations on the "Results of blows on the head," and to him is probably due the credit for first directing the attention of the profession to the history of "concussion." He narrates the case of a man lifting and striking his bowed head against the wall and falling dead, upon whom there was no evidence of injury, by wound, contusion, fracture, or tumor, but whose brain was found to be more than normally compact and too small to fill the cavity of the skull. No examination of the spine was made, and the possibility of a dislocation or fracture of a "cervical vertebra" was not considered or, at any rate, not alluded to. The case, however, furnished the basis for the claim that the violent shaking of the substance of the brain would produce death without demonstrable lesion. And the claim is made to-day by men held high in professional esteem and sustained by judge and jury, in the face of lesions in remote parts of the body, discovered on post-mortem examination, and certified by reputable physicians, to be a natural and sufficient cause of death—thus verifying the declaration of Petrarch, that "Great errors seldom originate but with men of great minds."

It was Hippocrates who, in effect, declared that a danger signal was lifted aloft whenever the slightest injury befell the head, and by consensus of all written opinions there is no diversity of view on that subject in the mind of any author. The same warning might be predicated of any injury to the "spinal cord," but the trust-worthiness of that signal becomes valid only on demonstrated injury—not on the mere suspicion of one. Abercrombie, in 1829, wrote, "Every injury to the spine is deserving of minute attention. Inflammation of the cord and its membranes may supervene; may advance in a very insidious manner—even after injuries that were so light that they attracted at the time little or no attention." True then, not less true to-day; but their harmfulness and their unerring recognition awaited the development of the more modern methods of diagnosis, and the ultimate results could only be brought to light by the post-mortem scrutiny of the microscope.

Prior to 1888, the functional or quasi functional disturbances of the "nervous system" received different designations from different observers, being called "Railway Spine," "Spinal Concussion," "Cerebro-Spinal Concussion," etc. Such a multiplicity of names worked only confusion, and resulted in their condensation under the one head "Traumatic Neuroses."

Oppenheim, in 1889, suggested the subdivision of this general subject into "Traumatic Psychoses," "Traumatic General Neuroses," and Traumatic Local Neuroses." To him and to Walton is due the credit of first calling

attention to the important fact that in all forms of "traumatic neuroses" the perversion of emotional functions is present, and often precedes the appearance of the more ordinary or "somatic" symptoms. These observers emphasize the fact that fright is the primary element in these "traumatic" mental disturbances, and in some victims the only symptom. That the majority of such cases result from violent shocks, such as are incident to railroad accidents, is generally admitted; but it is universally acknowledged that there is nothing specific in railroad accidents. Seguin declares that "the same symptom-group may be produced by any form of accident causing shock and fright." Putnam and Walton in 1883-4 expressed their conviction "That many of the symptoms of 'general or local neuroses' are due to mental, and not to spinal disorder." And this assertion paved the way for Charcot's idea that in many of these cases the symptoms are really of subjective origin and due to "auto-suggestion." Oppenheim and Knapp laid stress on this "auto-suggestion" factor in some of their cases, but it remained for Seguin in 1889 to show that "outside of deliberate malingering, even in cases of 'non-traumatic neuroses,' we are constantly confronted with the elements of exaggeration and positive false statement by patients who have no immediate pecuniary interests in view; and where there is a pecuniary interest involved he counsels a reservation of a positive diagnosis, unless there be present objective symptoms indicating well known lesions. Agnew, in 1888, declares it "Impossible to believe that 'concussion of the spine' can be a very frequent accident." He is at a loss to know, "Either from clinical experience or from revelations of the dead-house what phenomena disclose uncomplicated 'concussion of the spinal cord'." He concedes that "cases of death have been reported from such a cause but the limitation of the post mortem investigation to the 'spinal cord' fails to make conclusive the accuracy of the diagnosis." A man falling from a height, striking his buttock, transmits the force to the spine; "spinal concussion" it is called; and yet every symptom, the nausea, the vomiting, the loss of power in the lower extremities, the numbness, the tingling may follow bruising of the "sacral nerves" and shock to the "abdominal ganglia." To his mind it is not clear that there is anything peculiarly distinctive in those injured by collisions on railroad trains. Prior to 1886, Dr Lockhart Clark made and reported the only recorded post mortem of the spine following a railroad accident, and in this case the accident had occurred three and one-half years before the death of the subject. The usual signs of spinal myelitis and meningitis and associate softening of the grey matter of the brain were present. Very possible surely that the primary structural changes were located in the brain and not in the cord. Erichsen defines "concussion of the spine" "to be a certain state of the spinal cord occasioned by external violence, a state that is independent of, and usually, but not necessarily, uncomplicated by external lesion of the 'vertebral column.'" Clevenger accredits Erichsen as the author of the unusual and unprecedentedly diligent study of the diseases of the "spinal cord" that the last quarter of a century records; enlarges upon the frequency with which "spinal concussion" has come to the front in legal controversy; emphasizes the waste of millions of money paid to claimants, justly or unjustly, and charges much of the waste to the sad lack of an exact knowledge of the subject on the part of Surgeons and Attorneys. He asserts that all that is positively known about the "cord"

is the accumulated knowledge of the last fifty years, recorded by Longet in 1847 and later on by Kolliker, Stilling, Von de Kolk, Deiters, Gerlock, Schultze, etc. Leyden in 1875 added important contributions to its literature when Erichsen was practically master of the field. Erichsen adopts the Hippocratic dictum on the gravity of all injuries to the head, and enlarges on their importance when viewed by the light of the interesting fact pointed out by Brown-Sequard:—"That in many animals morbid states of various kinds may be hereditarily transmitted as results of injuries inflicted on the nervous systems of one or other of their parents." He recognizes in the writings of Boyer, Sir Charles Bell, Sir Ashley Cooper, and later on Olivier and Abercrombie, records of many cases revealing a series of phenomena latterly absurdly designated "Railway Spine"—phenomena that there were known and described a quarter of a century before the construction of the first railroad. He believes that since the introduction of railroads, accidents followed by such a train of symptoms have greatly increased. Page hoists Erichsen with his own petard, quotes his cases and demonstrates the scientific insufficiency of his explanations of "morbid phenomena;" asserts that of all accidents to which man is liable, none more serious can befall him than injury to the spinal cord, but insists upon the improbability of such through railway accidents. He thinks that under the name "Concussion of the spine," a number of complaints and symptoms only met with in the ordinary practice of the profession occur. Phillips Coombs Knapp, criticising the works of Erichsen and Page, thinks Erichsen's work, "Concussion of the Spine," compounded of too many distinct conditions to be trustworthy, and "Page's work 'Injuries to the Spine and Spinal Cord,' reads like a special pleader for Railroads." Dana paints a graphic picture of a scene in court, with the contending forces arrayed and armed for the legal fight. The attorney for the plaintiff, Erichsen in hand, confidently opens and reads the well worded descriptions of "Spinal Lesions," to the study of which, the distinguished English writer, John Eric Erichsen, has given the best years of his life, and points to his client as a pitiful example sent to show them practical, visual proof of the accuracy of his observations. The Attorney for the defendant proudly produces his more imposing looking volume by Mr. Herbert Page on "Injuries to the Spine," and in strongly accentuated voice, reads case after case of wicked "malingerers." He asserts that Mr. Erichsen has for years made a business of being an expert for people with injured spines, but that Page has never found a case that proved fatal. Dana then declares "that authorities are so unsettled and contradictory and symptomological data so uncertain, that two medical men may, with perfect honesty, if they go by written works, support opposite views."

A typical case may be thus summarized: It is night; a passenger wakes to the consciousness that he is in a railroad wreck. He hears the screams of the panic-stricken and the agonized appeals of the wounded. He is unconscious of personal injury; no wound or contusion marks the surface of his body. In railroad parlance, he is "shaken up;" in the language of science "Concussed." He escapes from the debris and renders needed help to the helpless. He congratulates himself on his narrow escape, and proceeds on his journey; but he has harrowing recollections of the wreck, and is nervous. In his waking thoughts he trembles at the memory of his recent experience, and his dreams are disturbed by his personal presence amid the crash of colliding trains. Time goes on. Some subtle, undefined

power has transformed the prompt, vigorous man of affairs into a morose, moody man. He no longer enters actively and earnestly in the business contest with his fellows in the mart of trade. A feeling of dependence leads him to loneliness, and the emotional side of self becomes supreme. Self-reliance is surrendered and friends mark an altered temperament. Vague pains creep into hips and back and loins, and to the sensitive touch of the surgeon the presence of exaggerated tendon-reflexes are revealed. Later on his attitude and gait evidence muscular changes; his down-sitting and uprising are marked by peculiar effort; locomotion is characterized by short steps with legs wide apart. Muscular weakness becomes marked—a weakness described by Oppenheim to “imperfect direction of motor impulses.”

Analyzed, such symptoms have but one meaning—exaggerated reflexes—the positive expression of altered molecular conditions. What that change is, science has thus far failed to reveal. Westphal “ascribes it to small foci of myelitis or encephalitis;” Bramwell “to multiple capillary hemorrhages in brain or cord;” Clevenger, “to undefined injury to the sympathetic nervous system;” others “to spinal concussion,” but spinal concussion is only a synonym for injury. Landon Carter Gray believes it a “Functional nervous condition due to molecular alterations in the brain or cord that have not been detected by our present methods of preparation and staining of nervous tissue.” He “doubts the possibility of its detection.” For simplification, he would call the disease “traumatic neurasthenia.” He believes that its symptoms, especially when consequent on railroad injuries, continue for a long time, often for years, and sometimes terminate fatally; “that the physical condition is a powerful factor in the complained of disability, that this psychical element, together with the resulting lack of proper treatment, makes the usual unfavorable prognosis of this class of cases;” declares that “they are not of unfavorable prognosis provided this psychical element can be excluded and prompt and proper treatment can be undertaken,” and says he is firmly convinced that “it is a more potent cause of the neurasthenia than the accident itself.” Erichsen’s assertion, “that fracture of the bones of the skull or spine gives immunity to the brain or cord substance,” Gray declares is utterly untenable.”

Dubois (Basel, Sept. 15th, 1892), expresses his conviction that neuroses originate from all sorts of accidents, that frequently and in consequence of very slight traumatism, the psychical element is the main factor; that in most cases the phenomena may be readily placed under the head of hysteria—a hysteria frequently mixed with neurasthenic symptoms, or the latter alone predominating. He would limit the term “traumatic neuroses” to the emphasizing of “Etiology.” Walton of Boston (*Journal of Mental Diseases*, July, 1891,) thinks it extremely difficult to injure the spinal cord except through the medium of the bony canal, and rejects absolutely the term “concussion of the cord.” He has seen cases presenting some clinical evidences of injury to the cord, but these evidences were never verified by post mortem proof. Osler (*Principles and Practice of Medicine*, 1892), says “All the train of symptoms belonging to the mis-called ‘Railway Spine’ may follow a profound impression,” and instances an engine driver developing the most pronounced neurasthenia following his running over a child. Schmaus of Munich (July 15th, 1891), working in the line of original investigation, experimented on the back of suspended rabbits. He laid

a board on the back of the animal, striking it a sharp blow with a hammer, producing, in some cases a temporary—in others a permanent paraplegia—dependent upon the number and intensity of the blows; but in no case did he find on post mortem examination lesions gross enough to be detected by the naked eye.

Preston (*Medical News*, March, 1893,) expresses his belief that it is possible to have "All grades of injury to the cord from mere temporary suspension of function up to a considerable degree of laceration without fracture of the vertebra." He believes it "not improbable that a severe fall will seriously disturb nutritive processes, working degeneration in the cellular structures with consequent weakness and atrophy of parts dependent for innervation on those particular cells." He reports the case of an injury to the lumbar region terminating fatally in two months, which on post mortem, revealed marked degeneration of the posterior columns in the cervical cord. He suggests that in the study of the etiology of spinal sclerosis it is not improbable that the influence of a possible trauma is underestimated. Walton (*Reference Hand Book of the Medical Sciences* 1888), rejects absolutely the propriety of using the term "Railway Spine." He believes it ambiguous, in that it fails to locate the seat of injury; he believes it misleading to the investigator, in that it directs attention to an organ which has probably little to do with the production of the symptoms. He insists that the theory which ascribes the prevailing symptoms in such reputed cases to spinal concussion is erroneous, and in the vast majority of such cases the theory is not tenable. He believes that most of the symptoms "admit of satisfactory explanation by disordered function of the cerebral centres, and are closely allied to, if not identical with, the recognized symptoms of the functional disturbances included under the names 'hysteria,' 'neurasthenia,' and 'hypochondria.'"

Watson (*Journal of American Medical Association*, 1891), proves by the presentation of the results of one hundred and forty-one original experiments on dogs, specially arranged for arriving at the exact scientific truth, touching the effect of injuries on the cord and its membranes, that the claim made by Erichsen "That the effect of slight blows on the spinal cord—whether to the back or to a distant part of the body, is not altogether a matter of modern surgical study arising from the prevalence of railroad accidents, but had, long antecedent to the introduction of modern means of locomotion, arrested the attention of observant practitioners," "is not true;" that it "actually does take a very severe blow and that blow to be delivered on certain limited areas of the body." He asserts that "Gross hemorrhage into the substance of the spinal cord or rupture of spinal membranes can be predicated of nothing short of fracture or dislocation of the vertebrae; that in not a single one of the dogs experimented on, did the post mortem pathological conditions furnish an example justifying the conclusion that injuries to the vertebral articulations were of greater gravity than like injuries to the carpal or tarsal articulations; and that in no case did the conditions found, warrant the expression of his belief that had the victims lived, inflammatory changes would have developed later. He denies that inflammatory and other morbid changes take their origin in spinal traumatism as often as Erichsen implies; does not believe that they ever arise when such injuries are not attended by immediate symptoms, or that they are necessarily more frequent after railway than ordinary accidents. He demands that it shall always be proven that no dis-

ease of the brain or cord existed at the time of the accident, that the inflammation was due to trauma and not to a vitiated constitution. He endorses Herbert Page's creed as to the exceeding rarity of spinal meningitis as an immediate result of localized injury to the vertebral column and his ignorance of any case in which meningeal inflammation has been caused by injury to some part of the body remote from the spine. He thinks it "absurd to ascribe to small punctate hemorrhages in the cord the power to set up inflammatory and destructive processes, is certain that no such case is on record," and makes bold to declare, "that there is not sufficient proof to justify the conclusion that any case of traumatic myelitis or meningo-myelitis has ever had its origin from molecular disturbances, or any pathological lesion which was invisible to the unaided eye, in an otherwise healthy spinal cord or its membranes. Experience has shown that inflammatory symptoms, if developing at all, are not usually delayed longer than four days.

In concluding, the following deductions may properly be drawn: First. That the lack of recorded autopsies is a sufficient explanation of our meagre knowledge of the exact pathological conditions to be found in the cord and membranes after injuries applied directly to the spine or in remote parts of the body.

Second. That the history of such cases as have been recorded demonstrate a want of thoroughness in investigation.

Third. That the demand for exact scientific proofs, as an aid to meeting out the fullest measure of justice to the living disabled, appeals to all surgeons, to whom the death of a patient affords an opportunity to make spinal autopsies, and to submit the pathological specimens to skilled microscopists.

Fourth. That to have the scientific world most profited by such microscopic investigation, it is the duty of surgeons to make careful observation and record of pre-existing symptomatology.

Fifth. That the rapid advances which the past quarter of a century have given to the study of nervous diseases, have developed a class of specialists in neurology, beside whom the ablest and best equipped surgeon is a mere tryo, in matters pertaining to nerve pathology; and suggests to corporations, unhappily involved in threatened or actual litigation as a result of spinal injuries, real or assumed, the wisdom of engaging the services of some disinterested neurologist of acknowledged skill, experience and honesty.

DISCUSSION ON DR. ROSS' PAPER.

Dr. J. H. Murphy, St Paul—Mr. President: I see my name is down on the programme to make some remarks upon the paper which my friend has just read. I was not aware of that fact until just now when I saw my name there. The Doctor read very fast and I could not keep up with him. I fully endorse everything he said, and I believe that one of the most important classes of injuries we are called upon to treat is injuries to the spine. I see a great deal of it. It is a good deal like spiritualism at the present time, more especially when we come before a court—the more we investigate it the less we know about it. I do not believe in one-half of the cases of injuries to the spine and I do not take much stock in it.

Now when I can read the Dr.'s paper over and meditate upon it there

might be some things that I could say; but I do not care to discuss the paper at the present time.

Dr. Briggs, Michigan—The questions relative to this paper are probably of far more importance to us in a medico-legal aspect as surgeons, than any other questions that will come before us for discussion; and before proceeding we should give this subject a careful consideration. We should, if possible, define some position that we as surgeons can take at the time when we pronounce a condition—a spinal concussion at the time the symptoms arise. The most of the symptoms that have come under my observation have arisen some months after the said injury has been produced. There are phenomena that we should be able to discern and settle this question at the time that these injuries are said to have been sustained. I hope that we will not go by this question without establishing some precedent by which we can be governed in future in these matters. We are often called upon in the matter of testimony relative to these conditions and, from the positions we occupy to-day and with our present knowledge, it is almost impossible for us to take the position that will protect ourselves, to say nothing about protecting others. I hope this subject will receive a full, careful and candid consideration and that it will occupy us a couple of hours in its consideration.

Injuries of the Spinal Cord and its Envelopes without Fracture of the Spine.—Anatomical Landmarks.

[By SURGEON JABEZ N. JACKSON, Kansas City, Mo.]

It is neither my purpose nor desire in this paper to enter into the minute or histological anatomy of the spinal cord. Time does not permit. There are, however, some features of the gross anatomy and of the relation of the cord and its investments, the clear understanding of which I consider of much importance in the consideration of the general subject under discussion. To these points, I shall as briefly as possible call your attention.

VERTEBRAL COLUMN-SPINAL CANAL.

The spinal cord, with its investing membranes, is situated in and protected by a canal in the vertebral column known as the neural or spinal canal. This canal is made up of a number of segments or rings, each formed by or constituting an individual vertebra. These segments when articulated together and firmly connected by the various vertebral ligaments, form an osseo-ligamentous canal extending from the foramen magnum above to the apex of the sacrum below.

The walls of this canal are formed by the bodies of the vertebrae in front; the pedicles, transverse, and articular processes laterally; and the laminae and spinous processes behind. The bodies which consist of a mass of cancellous with a thin incrustation of compact bony tissue, vary in shape from the segment of an ellipse with long diameter transversely almost to that of a circle. They form the principal bulk of the vertebral column and are united by (1) the inter-vertebral fibro-cartilages, and (2), the anterior and (3), posterior common ligaments. This portion of the column forms the posterior wall of the neck, thorax, abdomen and pelvis;

is deeply situated and safely protected from danger of most forms of direct violence. The neural arch which completes the circumference is formed by the pedicles and laminae bearing the transverse, articular and spinous processes. The pedicles project backward from the postero-lateral aspect of the bodies on either side. They are not connected by ligaments, but between consecutive pedicles spaces are left, which, bounded in front by the bodies and behind by the articular processes, constitute the intervertebral foramina through which the spinal nerves make their exit.

The articular processes of contiguous vertebrae are joined together by capsular ligaments, and form the posterior boundary of these foramina. The laminae are closely united by the ligamenta subflava; the transverse processes by the intertransverse ligaments; and the spinous processes by the supra- and inter-spinous ligaments. Thus a complete canal is formed opening only through the intervertebral foramina. The posterior aspect of this canal, or the neural arch, is further covered and protected by the many layers of thick dorsal muscles occupying the vertebral grooves; particularly by the Erector Spinae with its accessory prolongations and the Multifidus Spinae. The tips of the spinous processes are alone subcutaneous.

CORD AND MEMBRANES.

If we were now to dissect off the dorsal muscles overlying the column, and then remove by section that portion of the neural arch formed by the laminae and spinous processes throughout the entire length of the canal, we would open up the cavity of the spinal canal and expose to view, lying within, the spinal cord and its enveloping meninges. We are at once impressed with several marked differences between the arrangement here, and that of the brain and its meninges in the cranial cavity.

First. So completely is the cavity of the skull filled up by the brain, that frequently in trephining and other operations, even a considerable bulging of the brain substance into the opening in the skull is observed. The cord and its membranes in contrast do not nearly fill up the cavity of the neural canal, but lie loosely in its interior.

Second. The dura mater of the cord is not attached to the walls of the canal except loosely at some points by fatty tissue. The spinal canal has a separate independent periosteum, which takes the place of and is continuous with the periosteal layer of dura mater found in the brain. In the cord therefore we have only the supporting layer of dura mater, and even here it differs in the further fact that it is well separated from the cord and does not send prolongations into its fissures.

Third. Between the periosteum of the canal and the dura mater there is some considerable space, the extra-dural space, in which we find a certain amount of loose cellular or fatty tissue and also some venous plexuses of large size and great tortuosity.

The dura mater sends off tubular prolongations which accompany and invest the spinal nerves at their exit, finally merging into the connective tissue sheaths of the nerves. These nerve roots in their course are not taut, but lie loosely in the theca, thus allowing considerable movement of the cord in the canal without danger of laceration of the nerve fibers—an important provision.

The arachnoid is separated from the dura mater by a narrow sub-dural

space, containing a small amount of cerebro-spinal fluid. Between it and the pia mater is a much larger space known as the sub-arachnoid space also filled with cerebro-spinal fluid. Passing between these two membranes at various places are slender filaments of sub-arachnoid tissue, less abundant, however, than in the brain.

The pia mater presents two layers the inner layer closely investing the cord and dipping down into both anterior and posterior fissures; the outer dipping into the anterior, but not the posterior fissure.

CORD.

On dividing the dura mater and arachnoid by a longitudinal incision and reflecting these membranes, the cord, with the anterior and posterior nerve roots, are exposed within. Another feature of importance is now observed, namely: that the spinal cord does not extend the entire length of the canal, but terminates on a level with the body of the second or sometimes the first lumbar vertebra. A short distance above this point it begins to taper, forming the conus medullaris from the apex of which the pia mater is continued downward in the form of a slender loose filament, the filum terminale, or terminal filament, containing little or no nerve substance. This filament also becomes invested by the dura mater below and ends in attachment to the base of the coccyx.

COURSE AND DIRECTION OF NERVE ROOTS.

It is interesting and important to observe the course and direction of the nerve roots as they pass from their origin from the cord to their exit at the intervertebral foramina.

In the first spinal nerve the course is slightly upward and outward; in the second and third almost horizontally outward; and from here on the obliquity is increasingly downward and outward. Those nerves taking their origin from the lower extremity of the cord, have an almost vertical direction downward, extending far below the termination of the cord itself. From the peculiar appearance presented, they constitute what is called the cauda-equina (horse-tail).

TOPOGRAPHY.

The spinous processes of the vertebrae being our only available landmarks, it is well from a diagnostic standpoint, to observe the relation of the superficial origin of the spinal nerves to these spinous guides. To this end I here append the following complete table prepared by Reid, which I extract from Morris' excellent text-book on anatomy. A signifies the highest and B the lowest point of origin.

Second Cervical.

- (A.) A little above the posterior arch of atlas.
- (B.) Midway between posterior arch of atlas and spine of axis.

Third Cervical.

- (A.) A little below posterior arch of atlas.
- (B.) Junction of upper two-thirds and lower third of spine of axis.

WASH. D. C.

Fourth Cervical.

- (A.) Just below upper border of spine of axis.
- (B.) Middle of spine of third cervical vertebra.

Fifth Cervical.

- (A.) Just below lower border of spine of axis.
- (B.) Just below border of spine of fourth cervical vertebra.

Sixth Cervical.

- (A.) Lower border of spine of third cervical vertebra.
- (B.) Lower border of spine of fifth cervical vertebra.

Seventh Cervical.

- (A.) Just below upper border of spine of fourth cervical vertebra.
- (B.) Just above the lower border of spine of sixth cervical vertebra.

Eighth Cervical.

- (A.) Upper border of spine of fifth cervical vertebra.
- (B.) Upper border of spine of seventh cervical vertebra.

First Thoracic.

- (A.) Midway between spines of fifth and sixth cervical vertebrae.
- (B.) Junction of upper two-thirds and lower one-third of interval between seventh cervical and first thoracic vertebra.

Second Thoracic.

- (A.) Lower border of spine of sixth cervical vertebra.
- (B.) Just above lower border of spine of first thoracic vertebra.

Third Thoracic.

- (A.) Just above middle of spine of seventh cervical vertebra.
- (B.) Lower border of spine of second cervical vertebra.

Fourth Thoracic.

- (A.) Just below upper border of spine of first thoracic vertebra.
- (B.) Junction of upper one-third and lower two-thirds of spine of third thoracic vertebra.

Fifth Thoracic.

- (A.) Upper border of spine of second thoracic vertebra.
- (B.) Junction of upper one-fourth and lower three-fourth of spine of fourth thoracic vertebra.

Sixth Thoracic.

- (A.) Lower border of spine of second thoracic vertebra.
- (B.) Just below upper border of spine of fifth thoracic vertebra.

Seventh Thoracic.

- (A.) Junction of upper one-third and lower two-thirds of spine of fourth thoracic vertebra.
- (B.) Just above the lower border of spine of fifth thoracic vertebra.

Eighth Thoracic.

- (A.) Junction of upper two-thirds and lower one-third of interval between spines of fourth thoracic and fifth thoracic vertebrae.
- (B.) Junction of upper one-fourth and lower three-fourths of spine of sixth thoracic vertebra.

Ninth Thoracic.

- (A.) Midway between spines of fifth and sixth thoracic vertebrae.
- (B.) Upper border of spine of seventh thoracic vertebra.

Tenth Thoracic.

- (A.) Midway between spines of sixth and seventh thoracic vertebrae.
- (B.) Middle spine of eighth thoracic vertebra.

Eleventh Thoracic.

- (A.) Junction of upper one-fourth and lower three-fourths of spine of seventh thoracic vertebra.
- (B.) Just above spine of ninth thoracic vertebra.

Twelfth Thoracic.

- (A.) Junction of upper one-fourth and lower three-fourths of spine of eighth thoracic vertebra.
- (B.) Just below spine of ninth thoracic vertebra.

First Lumbar.

- (A.) Midway between spines of eighth and ninth thoracic vertebrae.
- (B.) Lower border of spine of tenth thoracic vertebra.

Second Lumbar.

- (A.) Middle of spine of ninth thoracic vertebra.
- (B.) Junction of upper one-third and lower two-thirds of spine of eleventh thoracic vertebra.

Third Lumbar.

- (A.) Middle of spine of tenth thoracic vertebra.
- (B.) Just below spine of eleventh thoracic vertebra.

Fourth Lumbar.

- (A.) Just below spine of tenth thoracic vertebra.
- (B.) Junction of upper one-fourth and lower three-fourths of spine of twelfth thoracic vertebra.

Fifth Lumbar.

- (A.) Junction of upper one-third and lower two-thirds of spine of eleventh thoracic vertebra.
- (B.) Middle of spine of twelfth thoracic vertebra.

First Sacral.

- (A.) Just above lower border of spine of eleventh thoracic vertebra.
- (B.) Lower border of spine of first lumbar vertebra.

Coccygeal.

- (A.) Lower border of spine of first lumbar vertebra.
- (B.) Just below upper border of spine of second lumbar vertebra.

VESSELS OF THE CORD.

The vascular supply of the cord and its envelopes is quite abundant, and the anastomosis especially free. Of the arteries there are anterior, posterior and lateral spinal, and medullary branches, derived from the vertebral, ascending cervical, intercostal and lumbar arteries. These vessels enter the spinal canal through the intervertebral foramina and by free and ramifying anastomosis supply all its contents.

The venous distribution is especially interesting. Of the spinal veins there are two sets.

(1.) The extra-spinal veins which form large plexuses both in front of the bodies of the vertebrae, the anterior extra-spinal plexuses, and also behind in the vertebral grooves, the dorsal extra-spinous plexuses.

(2.) The intra-spinal veins. To this second set belong the large plexus before mentioned which is situated between the dura mater and spinal

canal on the posterior surface of the dura and called the posterior intraspinal plexus. This plexus receives communicating branches from the posterior extra-spinal plexuses which pierce the interlaminar ligaments and enter the spinal canal. In addition to this plexus we have two pairs of longitudinal vein trunks, the anterior and posterior longitudinal spinal veins. These trunks further communicate with each other by numerous transverse branches, both in front and behind. Into the anterior veins empty the *venae basis vertebrarum*, which emerge from the cancellous substance of the bodies of the vertebrae beneath the posterior common ligament. Finally there are numerous medullary veins which supply the substance of the cord. In connection with the veins of the cord there are two points worthy of note: (1) That the spinal veins have no valves and hence readily dispose to congestion. (2) That many of these veins are in close relation to the vertebral ligaments and injury to the latter are therefore liable to be attended by more or less venous hemorrhage.

In closing there are some points which I desire to impress upon our minds.

First—The cord is enclosed in a complete osseo-ligamentous canal, the spinal or neural canal.

Second—This canal is deeply situated and protected by many overlying structures.

Third—The cord does not by any means fill the cavity of this canal either transversely or longitudinally, but lies loosely in its interior with considerable surrounding space.

Fourth—The cord is not connected to the walls of the canal except where the spinal nerves make their exit, and these connections are not taut, but extremely slack.

Fifth—Between each of the investing membranes a quantity of cerebro-spinal lymph is found, so that the cord is not only surrounded by, but practically floats in fluid.

In view of these facts I think I am warranted in concluding that no vital organ in the entire human economy is more thoroughly protected from violence than the spinal cord, and that, viewed from the standpoint of an anatomist, "concussion of the spine," strictly speaking, is a structural impossibility.

Injuries of the Cord and its Envelopes without Fracture of the Spine.—Physiology.

[By SURGEON A. P. GRINNELL, Burlington, Vt.]

In complying with a request from the committee on program to offer a few words on the anatomy and physiology of the spinal cord, I am quite sure no member of the Committee, or even of this Association, would expect from me anything which could be considered original, or even the expression of any fact or theory which cannot be found in the text-books or in many of the recent publications on this subject.

I presume a limited portion of the time of this Association in previous meetings has been and will continue to be taken up in a discussion of the diseases effecting the spinal column or spinal cord, and it is, therefore,

eminently proper at this time to preface the subject under discussion by reviewing some of the salient or important points touching the construction and function of this part of the nervous system. In fact, I am disposed to think that the object of your Committee in making this part of your program was simply to have rehearsed in a condensed manner the essential facts of physiology, thus refreshing the memory of those gentlemen who have in charge the more important part of the program, namely the discussion of the cord in a pathological point of view.

I need not remind the members of this organization, who have so long been associated with railway surgery, that whatever may have been the character or nature of the injury sustained by a passenger or employee in the railway accident, the importance which the spine has always played in making up a claim for damages.

In fact, I doubt if any injury sustained in a railway accident, however slight, insignificant, or ridiculous, it may have appeared, has ever occurred without the spine having served a purpose in magnifying the extent and importance of the injury.

Until the publication of Erichsen's book such was not the case. The medical expert relied upon his own judgment in discriminating between a real or fancied injury, basing his claim upon common sense reasoning, discarding theories which were without foundation, and asserting the presence of a lesion only when an autopsy had previously established the presence of a like condition.

The spinal cord is a cylindrically shaped organ, sixteen to eighteen inches in length, and relatively shorter in women, weighing, when divested of its membranes, about one ounce. It is held in the vertebral canal and reaches to the second lumbar vertebra, in all persons except new-born infants, where it is found to extend to the third lumbar vertebra. It is divided by name according to the divisions of the column into cervical, dorsal, lumbar and sacral portions, and corresponds with all of the nerves given off from these sections. It is nearly round in shape upon section, except in the lower region of the cervical where it is somewhat flattened antero-posteriorly. The average diameter of the cord throughout its length is about two-fifths of one inch, and has on its course two noticeable enlargements in the cervical and lumbar regions. It is covered and surrounded by three membranes corresponding in construction and name the same as envelop the brain, namely, the dura mater, arachnoid and pia mater.

The dura mater has the same relation to the cord as it bears to the brain, an external covering extending from the foramen magnum, to the edge of which it is attached, and extending down as far as the second sacral vertebra.

It is readily seen from this that its cavity is much longer than the spinal cord. It extends to the second sacral vertebra and is held loosely in this bony canal by twenty-two lateral ligaments.

The arachnoid, as its name implies, is thin, nearly transparent, and is found lying over the cord and roots. Internally it is attached and connected by tissue filaments to the internal membrane or the pia mater.

The latter covering has a vascular sheath closely applied to the cord, and upon which the cord depends for its nutrition. We have an arachnoid cavity existing between the dura and arachnoid membranes, in which is found a small quantity of fluid; also a cavity existing between the arachnoid

and pia mater in which is found a larger quantity of fluid, both cavities connecting with like spaces in the brain, and recently has been determined that the cavities connect with each other.

The spinal canal is much larger than the spinal cord, which allows great latitude of motion to the cord, in most of its extent between one-half and one inch.

Anatomically considered, the cord is divided into columns called anterior, lateral and posterior, composed of gray and white matter, the gray internal to the white and having anterior and posterior horns or roots and arranged very much like the letter H.

The anterior horns do not approach the surface of the cord to the same extent as the posterior and they lack a very important development found upon the posterior horns outside of the dura mater, namely, the posterior ganglion.

The white matter or external envelope of the spinal cord is the natural conductor of impressions to and from the cord cells and the means of communication between the brain and remote parts of the body.

The gray matter is composed of cells arranged in groups and surrounded by a plexus of cell processes and nerves; the cell groups are named in accordance with their position, internal, antero-lateral, median, posterior and the cells of Clark's column. The cells of the anterior horns are large compared to the posterior and they vary to a certain extent in size, in different portions of the cord, being larger in the cervical and sacral enlargements of the cord than in other portions.

Beside the anterior and posterior column, composed of gray matter and forming so large a part of the spinal cord, and upon which the cord depends more especially for its many and peculiar functions, we have imbedded in the white substance in the posterior part of the cord, and upon each side of the posterior median fissure, the columns of Goll, and lying in close proximity to, and in contact with the posterior horn, is the column of Burdach.

Outside of the gray matter formed between the anterior and posterior horns, occupying the space known as the lateral column, are found the portions called the "direct cerebellar tract," "Gower's tract" and the "crossed pyramidal tract." Lying anterior horns of the gray matter are found upon each side of the anterior, median fissure, the direct pyramidal tract, connected with and a part of the column of Turch.

The motor fibers of the cord can be traced only to the anterior and lateral columns, and those found in the column of Turch are connected with the corresponding hemisphere of the brain while those of the crossed pyramidal tract are connected with the opposite hemisphere.

The posterior columns of each side, including those of Goll and Burdach, convey sensory nerve fibers which are connected with the tactile sense and to the fibers connected by the commissures; it is therefore noticeable that in this portion of the spinal cord both tactile sensation and co-ordination of muscle are found.

It is attributed to the lateral columns of each side, the probable power of conveying through the vaso-motor fibers the properties of sensation.

The function known as trophic is attributed to the nerve cells found in the anterior horns of the gray matter and it has been noticed that when destroyed or the nerve fibers arising from them undergo degeneration, the muscles supplied by those fibers undergo atrophy.

In a physiological point of view, the functions attributed to the different portions of the spinal cord can be summarized as follows:

The white matter is a conductor of nerve impulses; the crossed pyramidal tracts carry motor impulses in a downward direction from the brain; a few fibers can be traced to muscles connected with the same side, which explains that in hemiplegia there is more or less weakness on the healthy side.

To the columns of Goll are attributed the special sensation from the muscles and articulations by way of the root of the same side. When these portions are diseased, there is, as is well known, a loss of the sense of position of the limb, or loss of the power of estimating weights and of coordination of muscular effort. The fibers of this column cross in the medulla.

The general function attributed to the columns of Burdach is known as tactile sensations; coming in from posterior roots of the opposite side, they contain many associate fibers which connect them with each other and with their fellows of the opposite side.

The sense of pain known as the "pain fibers" or "excito-reflex fibers," which originate from the posterior root, run through the columns of Burdach and reach the motor portion of the spinal cord in the anterior horns. Other fibers also are traced to the column of Goll. It is therefore well understood that through these columns the impulses are connected to most of the sensory and motor portions of the cord. When disease attacks these columns, you have a variety of symptoms, as pain, anaesthesia, ataxia and more or less loss of the reflexes. The fibers of this column cross at once to the opposite side.

The tract known as the "anterio-lateral" conduct the sensations of pain and temperature which have been communicated from the opposite side and is carried by the anterior and posterior commissures.

The different cells or nerves of the cord are so arranged in plexus groups, presiding over certain functions, that they respond in a more or less definite way to stimulating impressions. For instance, the cilio-spinal center extends from the 7th cervical to the second dorsal segment and when anything interferes with its normal condition by stimulation, it causes the pupils to contract.

The genital centers reach from the first to the third sacral segment.

The bladder and rectal centers are in the fifth sacral segment, the bladder being perhaps a trifle lower.

The vaso-motor centers spinal extend from the second dorsal to the second lumbar portions.

The gray matter chiefly contains groups of cells which act as centers and have power of distributing nerve impulses. The arrangement of the cells in different portions of the cord are somewhat peculiar, the larger ones being on the outer surface of the horn and send fibers to the larger muscles of the body; the more central ones are connected with muscles having more delicate functions and the smaller, still, in the central portion of the cord matter, are known as trophic cells and bear an influence upon the bones and joints and the functions of secretion; among some of these groups are mentioned as spindle-shaped cells and impulses communicated to these cells are carried directly to the cerebellar tract and to the brain itself.

It is not sufficiently established to warrant the unqualified statement that the functions accorded to the spindle-shaped cells is to conduct impulses from the viscera and to the coordination of muscles. They are no doubt, in some way, connected with and associated in the functions attributed to the columns of Goll and to Clark's column which acts as a center for the vaso-dilators.

It cannot be fully attributed to the posterior horns, the function, alone, of sensation, but in these horns largely exist a function connected with the tactile-pain reflexes and temperature. It is, however, well established that in the posterior horns lie the trophic centers for the joints, skin and bones.

By reference to the accompanying diagram the reader will be able to trace the different columns as shown by a transverse section.

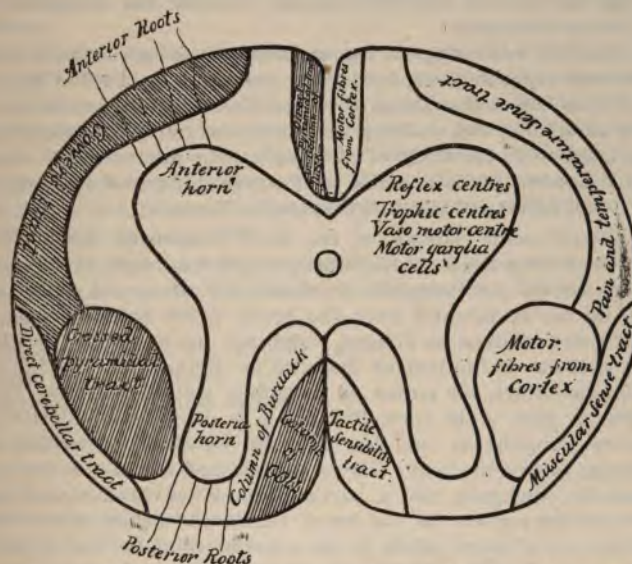


FIG. 1.—Diagram of Transverse Section of the Cord,* showing Anatomical Topography on the Left, and Physiological Functions on the Right Side.

For us to arrive at a definite conclusion regarding the general properties and functions of the spinal cord, it is necessary to carefully weigh and consider all the conflicting statements made by authorities upon this subject. It is a problem of no easy solution when it is found that even Galen made many experiments upon animals, carefully noting the effects of injuries to different portions of the cord and published the results of his observations, established even at that early period certain facts which have stood the test of criticism and are acknowledged to be fundamental facts.

We are indebted to Stilling, Clarke, Kolleker, Magendie, Brown-Sequard, Flint, Starr, Dana, Chanvean and a score of others who have made the physiology of the brain and spinal cord a life study and have added much

to our knowledge of this complex and important subject. Has any portion of the human body received so much careful study and investigation as this and can the anatomist or physiologist find a greater reward for his efforts than is shown in the well established facts pertaining to the cerebro-spinal system?

Electricity, the microscope and experiments upon living animals have enabled us to settle questions long under dispute and discussion regarding the functions of nearly every portion, column or cell of the spinal cord and to clear a cloud of doubt so long surrounding our knowledge of the relations which exist between the functions of the cord and remote parts of the body.

While there may yet be many questions unsettled respecting the functions attributed to the central pyramidal tract, columns of Turck, Goll and Burdach, or the physiological relations which they bear to each other. Still, enough has already been determined to settle the important points involved in this discussion.

After carefully reviewing all the essential physiological facts advanced by authors and experimenters during the past century, Prof. Flint is able to extract from this accumulated evidence the material necessary for us in forming an opinion and enabling us to solve many of the intricate problems associated with the study of this topic. His summary of the spinal cord as a conductor of both motor and sensory impressions, contains to my mind a full resume of the entire subject. He says:

"The antero-lateral columns of the cord, comprising that portion included between the anterior median fissure and the origin of the posterior roots of the nerves are insensible to direct irritation, and serve as conductors of the motor stimulus from the brain to the anterior roots of the nerves. If these columns be divided, voluntary motion is lost in all parts below the section. If the rest of the cord be divided, leaving the antero-lateral columns intact, the power of voluntary motion remains. Throughout the greater part of the cord, this action is direct, and division of the antero-lateral columns on one side produces paralysis of motion on the corresponding side of the body. There is a decussation of the motor fibres at the medulla oblongata, and a partial decussation in the cord itself in the upper cervical region. In the dorsal region and below, the motor conducting fibres are situated chiefly in the anterior columns; but in the cervical region, these fibres pass to the sides and are contained chiefly in the lateral columns. The conductor of motor stimulus is probably not affected exclusively by the white substance, but is transmitted in part by the gray matter.

The gray substance of the cord serves as the medium of transmission of sensory impressions to the brain. This is effected chiefly by the gray matter surrounding the central canal, but it may take place to some extent in other portions. If the entire gray matter be divided, with but slight injury to the white substance, sensation is lost in all parts situated below the section. The white substance does not conduct sensory impressions to the brain, either in the antero-lateral or the posterior columns. The most probable function of the white substance of the posterior columns is to unite the different segments of the cord together by longitudinal commissural fibres; and this portion of the cord has an important influence in coordinating the muscular movements.

The sensitive nerve-fibres from the posterior roots of the spinal nerves

pass in the cord for a short distance upward and downward. They then penetrate the gray matter, and decussate throughout the entire length of the cord. Division of one lateral half of the cord is followed by complete paralysis of motion on the corresponding side of the body in all parts below the section; anaesthesia in all parts below the section, on the opposite side of the body; and hyperaesthesia in the parts below the section, upon the corresponding side of the body.

The anatomical points bearing upon the physiological action of the cord are the following:

The fibres from the anterior roots penetrate the anterior gray cornua directly and are in immediate connection with the prolongations of the motor cells. The motor cells also have prolongations which pass to the brain in the white substance. The motor fibres are thus directly connected with the cellular elements of the cord, the elements probably concerned in reflex movements, and the cells are in connection with conducting fibres to the brain.

The fibres from the posterior roots take several directions. Some of them pass to the gray substance. A portion passes to the posterior columns, some extending upward and others downward. The decussation, which is rendered certain by physiological experiments, has not been satisfactorily followed by anatomists. It undoubtedly takes place in the gray substance, probably in part by a crossing of the fibres themselves, and in part by a crossing of prolongations from the cells with which certain fibres from the posterior roots are connected.

For convenience of reference I subjoin a table (partly formulated by Dana), which shows the subdivision of the anterior, lateral and posterior columns in detail:

The anterior columns are divided into—

- Direct pyramidal tract.
- Anterior fundamental column.

The lateral columns are divided into—

- Lateral fundamental columns.
- Lateral limiting layers.
- Crossed pyramidal tracts.
- Direct cerebellar tracts.
- Antero-lateral ascending tracts, or Gowers' column.

The posterior columns are divided into—

- Postero-internal column or column of Goll.
- Posterior-external columns or column of Burdach.
- Rim zone, or column of Lissauer.

Burdach's column is divided into—

- Anterior root zone.
- Middle root zone.
- Oval root zone.
- Posterior root zone.

Injuries of the Cord and Its Envelopes without Fracture of the Spine.—Experimental and Clinical Research.

[By Surgeon Thomas H. Manley, New York City.]

Before I proceed with my lines I take this opportunity to sincerely thank you and the members who have honored me with the position which should have been filled by our late distinguished brother, Dr. Watson. I may say, also, in this connection that it is very earnestly to be hoped that the scientific work of this association will be on a level with, or rather above the level of, what has been accomplished in his direction by surgical societies in this country up to the present time; because of all the branches of the surgical art, there are none, perhaps, in which there is greater necessity, for the railway surgeon to be skilled and efficient in, than those lesions of the spine of traumatic origin. (Applause.) Before commencing a consideration of this part of my study of spinal lesions, I must acknowledge my utter incapacity, to fill that hiatus, which the relentless hand of fate has occasioned, in the present instance through the death of our beloved and honored, fellow-member, Dr. B. A. Watson; that giant mind, accomplished scholar, indefatigable worker, and one of the greatest, if not the greatest, of American surgeons of his time.

He was not only a man profoundly learned in every thing, cognate to the craft of surgery, but he was also an independent and original investigator; and his love for truth and justice were among his most dominant characteristics. To him, more than to any other of the great lights who have been benefactors to mankind, for advancing in our knowledge, and placing the study of traumatic spinal lesions on a sound scientific basis, are we, and the whole professional world indebted.

In the same brilliant galaxy as Wells and Bigelow of Boston, Marion Sims of New York, Senn of Chicago, and others, the name and fame of Watson, rests, as one of those, few who have shed luster on American surgery, whose names in memory we reverence and whose work will last as long as posterity itself.

Dr. B. A. Watson was one of those few independent observers, who, while they maintained the highest respect for Mr. Erichsen, and not for a moment questioned his honesty or sincerity, never, however, could quite reconcile themselves to those doctrines and theories on which he constructed the "railway spine." He, on the contrary, reasoning on the syllogism which is recognized as a law in all traumatic lesions of the human body, took issue with the English surgeon and boldly declared that the rachidian structures were subject to the same identical pathological laws, when they sustained physical violence as any others; and, that after spinal injuries, clinical symptoms must correspond with pathological changes. But, however rational this assumption might seem, it was yet a mere allegation without support.

This, Watson fully appreciated himself; and hence, in order to for once, and all time incontestibly demonstrate the soundness of his position, he turned to experimental surgery, on the anaesthetized lower animal. Speaking himself on the subject, he said: "The author was prompted to undertake this laborious investigation in order that he might add something if possible to our present limited and very unsatisfactory knowledge of those

lesions which had been discussed by Erichsen and Page, under the caption of 'Nervous Shock,' 'Concussion,' 'Injury of the Spine and Spinal Cord,' etc.**

His experimental work occupied nearly five years; entailed an enormous sacrifice of his personal attention, a large financial outlay, arrest and many fines. But, with a strong and unshaken determination, he finally overcame all obstacles and triumphantly completed his series of experiments of concussive injuries of the spine, traumatizing therefor 141 dogs. The work of experimentation, committing to record and publishing this series was completed in the spring of 1890.

No doubt, had not his general health commenced to give way soon after this immense task was undertaken we would have been favored at this meeting with another series, which would have aided to illumine another phase of spinal injury besides "Concussion."

Thinking that possibly Dr. Watson had material arranged for this session before he was suddenly called away, I wrote to his family with the hope that an extant, posthumous essay, might relieve me of the anxiety and responsibility which my present task involved. But in this respect I have been disappointed; as Dr. Ingels, the late doctor's son-in-law, informs me that none such was prepared; and that the scattering data collected could not be well utilized by me; besides a full consciousness of my inability to do anything more than give the "Shadow of the Substance" as a substitute for our distinguished deceased colleague, I see, as I take up the subject that I am confronted by another difficulty. It will be noted that we are supposed to be restricted by the title of this discussion to "Injuries of the Cord and Its Envelopes Without Fracture of the Spine." This title strikes me as being so vague and indefinite as to very seriously embarrass and confuse our studies; besides, very materially diminish the full value of our researches and conclusions. This is self-evident when we essay to interpret what is meant by the spinal cord and what we are to understand by its envelopes. All text books on anatomy include the meninges as an integral part of the spinal cord.

If, in this first part, we accept this in its literal sense, and that established by general usage, we must interpret its envelopes to refer to the vertebral walls, muscles, fascia and integument.

If we are to rest on that construction of term, then indeed we must include under this category a number of lesions, for injuries extrinsic of the anatomical elements of the spinal cord are as common and harmless as those intrinsic to the cord are unusual and grave.

If we must eliminate fracture the field is greatly narrowed; for, in my experience, serious injury to the spinal marrow, without fracture of bone or displacement *par arrachement* by the tearing of ligaments, except in punctured wounds of the cord by narrow, sharp-pointed instruments, is comparatively uncommon. Hence, if we must eliminate the term fracture in its broadest sense as laceration of the vertebral ligaments and arteries and diastasis of the smaller apophyseal articulations, then, indeed, the extent of our labor will be very greatly reduced, for, as a rule, it is utterly impossible for violent disorganizing force to act on the medullary elements, without having in its transit through the soft parts and osseous walls im-

**"Experimental Studies of Lesions Arising from Severe Concussion," B. A. Watson, published by Blackston, Son & Co., Philadelphia, Pa., 1890.

parted a maximum of its force, first, on such resisting structures as lie in its way. Frederick Treves, in his "Handbook on Anatomy," compares the spinal cord to a body, which is suspended in a fluid medium on every side, encased by powerful protecting walls. Now, he says, that it is quite impossible to disorganize that floating body until the outer-lying structures first give way.

Therefore, in spinal injuries of concussive, percussive and succussive origin it is quite evident in obedience to the same precise physical law traumatic lesions involving the medulla can seldom occur, except in association with serious injury to the overlying parts, or adjacent neighboring organs or structures. There is yet another impediment in the way in this segregation of study, viz.: that as it is divided under thirteen separate heads a free expansion and unfettered expression of opinion by each contributor is liable to lead to such an extension of the subject that it would be impossible for each worker to avoid trespassing on his neighbor's domain.

GENERAL OBSERVATIONS ON THE COMPARATIVE VALUE OF EXPERIMENTATION ON THE SPINE OF THE LOWER ANIMAL AS CONTRASTED WITH CLINICAL PHENOMENA AND POST MORTEM DEMONSTRATION ON THE TRAUMATISED SPINE OF MAN.

In approaching the study of lesions of the medullary substance, meningeal and other investments of the spinal cord it is proper that it should be clearly understood that the knowledge derived from experimentation thereon possesses but a relative rather than absolute value when carried out, as it must be largely on the lower animal. Yet, in order to appreciate the mechanism in causation and to place the study of phenomena and pathological changes observed in the rachidian structures after injury on a scientific basis, with an opportunity to observe the complex morbid anatomy of the grosser lesions, it is only by experiment conjoined with clinical observation that this is possible. Speaking on this subject* Dr. R. L. Bowles declared that "Almost all the work of surgery is done by the application of the laws of physics. Injured parts and broken limbs are kept at rest, dislocated limbs are placed in a natural position, redundancies are removed and deficiencies are supplied; crooked parts are made straight; blocked and narrow ones made patent, stiffened joints are made to move, crooked limbs are put into shape, eyes made to see, that would not, ears made to hear.

Surgery then is a department of physical science."

Quoting from John Simon, he continues: "The experiments which give us our knowledge with regard to the cause of disease are of two sorts: on the one hand, we have the carefully prearranged, comparatively few, experiments made by us in pathological laboratories, for the most part on the lower animals; on the other hand we have the experiments which accidents do for us, and above all, the incalculably large amount of crude experiment which is done by man on man under our present ordinary conditions of social life, and which give results for interpretation."

In contrasting commercial experimentations, he cited the report of the London water companies from 1848 to 1853, in the presence of the cholera in which both gave the same results. But the commercial experiments cost many thousand human lives, while the scientific experiments which were

*Introductory address at St. George's Hospital, London, October 5th, 1892.

infinitely more exact in justifying a presumption of danger the lives of just four mice were sacrificed. Rosenthal (Die nervous system, page 12), speaking on spinal infirmities, said, "Contemporaneous medicine has applied all its energies to dissipate the profound obscurity which has hitherto enveloped deceased conditions of the spinal cord. The progress of experimentation even mixed with careful clinical investigation have equally contributed toward this end. In proportion as the light is thrown on the morbid forms and types, hitherto unrecognized, grow more and more clear, take their place in the growing list of observations, and permit us to hope that other phenomena, which are still obscure will follow in their course. Spinal diseases for a long time misconstrued or passed by in silence have been the subject of profound study and extensive experimentation during our time which have greatly aided toward perfecting diagnosis and treatment."

Indeed, it must be conceded that experimentation occupies a position in the front rank in importance as a means of enabling us to now intelligently unravel the many complex problems which have hitherto rendered a clear comprehension of many human infirmities impossible. Nevertheless, while conceding this, it should be distinctly understood that it can never take the place of what Dr. Bowles has so graphically described as "those experiments on man caused by accident or injury," combined with thoroughly, intelligent and painstaking work, *post mortem*.

In a contribution* formerly submitted by me on spinal injuries, attention was called to the wide difference in the moral and physical make-up of man and the lower animal.

The late Dr. Watson's experiments were directed solely to but *one* phase of physical injury of the spine. The force which was applied was *concussive* violence; direct, evidently intended for the purpose of either supporting or refuting the claims of the "Railroad Spine," which is always said to follow concussive motion. This series of experiments are unique in the history of surgery; and what adds to their great interest and value is a fact that the morbid anatomy and pathological changes were not only vouched for by Watson, but were carefully conducted, examined and recorded by Dr. Frank Fergusson, the accomplished pathologist of the New York hospital. But the distinguished investigator was met at the first step of his work with the most poignant disappointment, for not only did the concussive force not concuss the spine at all in many, but killed the animals outright through bursting of the heart or blood vessels; while, in others, which escaped with their lives, some were merely "hobbled," others suffered from rupture of the muscle, broken bones, and lacerated internal organs and one or two were able to get up and run away.

As a matter of fact in this series of 141 cases there were but about one-fourth in which the structures of the spine suffered any serious injury, and not a single case is recorded of disorganizing lesions of the medullary substance of the cord, or the meninges in which their investing osseo-ligamentum investment escaped.

But experimental work on the spine made to determine the effects of concussive force, as I will later demonstrate, is extremely inexact. We may investigate in the same precise lines in the three great cavities, but,

*Traumatism of spine resulting from railroad and other injuries; the etiology, diagnosis and pathology. Jour. Am. Med. Assn., Nov. 14, 1891.

there is no analogy in the simplicity of construction in one, and the complexity of construction in the other.

With one who has an active service with traumatic surgical cases, in any one of our large modern cities, with high buildings and flagged sidewalks, with extensive railway travel through the public thoroughfares, he will almost constantly have abundant opportunities to observe and study the results of spinal injuries on the living, and examine the seat of lesion in many *post mortem*.

To the latter class of cases, those which may perhaps be designated "accidental experimentation" on the human spine, particular attention will be directed in the present instances; though there will be included a synopsis of a series of experiments, which I have made on the lower animal, with a view of endeavoring to establish the most common anatomical site of intravertebral hemorrhage of a traumatic origin; besides studying the mechanism and immediate resulting consequences of direct violence, of wrenches and torsion of the spine.

PART I.

EXTRINSIC AND INTRINSIC INJURIES OF THE BACK, WHICH, IN VARYING DEGREES, INVOLVED THE GREAT NERVE CYLINDER OF THE SPINE OR CEREBRO-SPINAL CENTERS IN MAN.

Now proceeding to the study of spinal lesions, following in consequence of accidents, or direct mechanical force, it is easy to perceive the great difficulties which beset one's path. For modern studies and investigations, singular to say, but nevertheless true, has rendered the task more complex and intricate than ever.

It has been my good fortune during the past ten years, particularly, to meet with and treat a large number of nearly every conceivable phase of spinal traumatism. The Ninety-ninth Street and the Harlem Hospitals, with which I have been connected as assistant and visiting surgeon during that period of time, until recently, included in their respective ambulance districts, all that territory north of the geographical center of New York City, and southward to Eighty-fifth street, within this area, were all the railway approaches to New York City from every section of this country; very extensive freight yards; the three parallel lines of the elevated railway system, the cable, trolley and horse railways.

And besides, as this territory of recent years has been the active center of very extensive building operations, blasting of ledges, factory industries, etc., it is but fair to assume that my confreres in hospital service, with myself, have had abundant and unusual opportunities to witness, investigate and treat nearly every conceivable phase of traumatism; and that necessarily there must have been among the injured a considerable share of spinal lesions.

I was not long in active hospital service before two things particularly attracted my notice.

First—That in all grave spinal lesions little was attempted in the way of treatment of them except by palliative measures; and, second, that in those cases in which the local and general symptoms pointed to indubitable evidence of direct disorganization of the Spinal Cord they almost invariably pursued a promptly fatal course.

I soon noticed another significant feature in connection with these several traumatisms, viz.: That in serious cranio-cephalic injuries (more than 200 of which I have now separately studied and treated—140 reported up to July, 1890), when not immediately mortal there were, in a considerable share, distinct evidences of inflammatory changes, extending in a centrifugal direction and involving the bulbar and spinal nerves, in the upper segment of the cord, before death. While, on the other hand, it is clearly evident to every one who has watched a spinal traumatism which pursues a fatal course, that pathological changes advance in a centripetal direction and cut off life only when the base of the brain is reached.

A considerable proportion of my cases was of a mixed character, in which the shock of violence had been sustained simultaneously by the brain and spinal cord. This is a common but a noteworthy condition of affairs. In many of those cases in which the cervical segment is injured by a fall on the neck, side of the head and shoulder, this condition will obtain.

Those accidental experiments, so to speak, on man, when the spine is injured, in this connection furnish us with quite precise data for study and investigation. A public hospital experience with this class of cases is peculiarly valuable, for here we often meet with those spinal cases under such circumstances as generally preclude the possibility of shamming. The majority of the cases here cited and tabulated were spinal injuries consecutive to concussive force, it being applied both directly and indirectly. Our patients suffering from mortal spinal injuries were nearly all males. The simulated cases were mostly in women. We had no cases of fracture in children who survived injury for any considerable length of time. There were 16 deaths, 15 *post mortem* examinations, of which records have been preserved in 11.

The cases taken as a whole may be grouped into the following classes:

- (a) Embrace the simulated, 6.
- (b) Lesions of the cervical, 17; dorsal, 20; and lumbar regions, 34.
- (c) Spinal hemorrhage and consecutive meningitis, 46.
- (d) Lesions of the cord complicated by injuries of the extremities, 18.
- (e) Excentric lesions predominating, 14.
- (f) Cases recovering full functional power, 38.
- (g) Cases recovering but partial functional power, 5.
- (h) Cases treated by surgical operations, 2.
- (i) Cases of concussion of the spine—"Railway Spine"—0.
- (j) Punctured, incised or lacerated wounds of the spinal cord ending mortally, 10.

CASES ENDING MORTALLY.

In this category are included (1) those who succumbed from the violence of injury before reaction set in; (2) those who died from injuries to their internal organs in association with those of their rachidian structures; (3) those ending mortally from the mechanical pressure over the ganglia or centers of the cords which preside over respiration; (4) those in which life was lost through hemorrhagic or other pressure, exciting ascending meningitis or myelitis, bed sores, etc.

If there is any one thing more than another which my experimental work and clinical observations have clearly demonstrated to me it is that

in all spinal injuries dependent on concussive force the internal organs, coincidentally, suffer more or less damage to their integrity.

Spinal injuries in the cervical region are the only exception to this rule, as there the bodies of the vertebra lie in immediate contact with hollow empty cavities. Indeed, it would be absurd to assume the contrary; to allege that an organ so deeply lodged and well protected as the spinal cord could suffer extensive medullary disorganization by any species of shaking, commotion or shock without those solid passive organs like the kidney, spleen, liver or heart, being shaken by the same force. These are the cases in which almost immediately after injury, and before reaction sets in, death ensues.

But there is another type of the same class in which the extent of damage to viscera is not so great, though from hemorrhage, displacement or laceration of organs, the bursting of the stomach, intestines, gall or urinary bladder, complications arise which, rather than medullary disorganization, cut off life.

In the cervical segment when mechanical pressure of the cord, through either hemorrhage or displaced bone, is above the fourth cervical vertebra, mortal asphyxia may cause death in a few hours. But with those mortally injured in whom life may linger several days, death, in the majority of cases, is caused by consecutive changes in the meninges and medulla, subsequent to pressure at the point of injury, snapping the vital cord, as it were, as the roots of respiratory reflexes in the neck, or base of the brain, are reached.

SIMULATED AND GENUINE CASES.

This division has been made in order that it may be well known that a considerable number of cases will come under our observation for either diagnosis or treatment; in which *clinical* observation alone will aid us, for in this class no number or description of experiments on the lower animal will shed the least ray of light.

Since the famous cases of Guérin*, in which, after a most protracted and critical investigations by a special commission of the French Academy, it has been conceded that many have the faculty of distorting their spines into almost every conceivable shape.

These simulated cases will either be in hysterical, in designing women; or those who are suffering from a concealed lesion of the pathological origin. All of those cases which have come under my care, with few exceptions, have been outside of hospitals, in which damages against individuals or corporations were claimed.

Some of them may be real, in their own imagination. They imagine they are injured, take the bed and discontinue all exercise. Of course, in time, through muscular inaction, we will find trophic changes in the soft parts, with, perhaps, some stiffness in the articulation. With another group all the symptoms are shammed. Here examination will utterly fail us, for of the regions of all the body there is none in which, even in this age of progress, that pathological changes are so meagerly comprehended as

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in the spinal cord. And besides, there is no test or tests, singly or together, which will definitely determine even the relative integrity of the spinal system in a large number.

This is the class of cases which Page so graphically described, of which he says*: "Of what earthly use are many of the instruments of the specialist in special examination, as the dynamometer, audiometer, lenses, battery, etc., unless you know your patient is telling the truth? You discover, forsooth, that he presses fifty pounds at the right hand and ten pounds at the left, and you forthwith create the scientific basis of a lie." Again he adds: "Amongst the leading methods of examination there is none more fallacious or untrustworthy than that which we frequently hear called the 'electrical test.'"

Of all the genuine cases of spinal injury, if a crippling condition follow recovery, little need be said, as it is quite enough that the antecedent and personal history of the patient be thoroughly sifted. His physical condition usually speaks for itself.

Vaso-motor disturbances, trophic changes in the muscles, and marked wasting, particularly, are more or less noticeable. In those cases in which consecutive organic changes are unmistakable, what should be sought for, when occasion requires it, is to ascertain the *extent* and *degree* of degenerative changes and the prospect of ultimate recovery of the functional integrity of the injured parts.

REGIONAL LOCATION OF SPINAL-CORD TRAUMATISMS-LUMBAR, DORSAL CERVICAL AND SACRAL.

The spinal column, as might be expected from its construction, outline and composition, is proportionately exposed and susceptible to the effects of physical forces. Accordingly, those lesions of the cord following injuries are the more numerous in one segment than another of the vertebral hollow; but the resulting lesions are also dependent on different anatomopathological changes incident to sustained traumas. The type development, progress and termination observed, too, are quite distinct and peculiar to each, as are also the clinical features and prognosis. Therefore, as we might expect in the lumbar region, the cauda-equina being deeply lodged and the vertebrae the deepest buried, the medullary substance is least often injured. However, spinal hemorrhage is most common in this situation. The clinical peculiarities are the well-known phenomena that recovery without paralysis above the lumbar plexus may be possible with paraplegia; and, in fatal cases, the slow progress which they pursue from the symptoms of spinal injury is well accenuated. Renal complications are invariable accompaniment of serious lumbar lesion.

It may be said that in the greater proportion of these cases the patient's strength is worn out and the bodily powers yield rather to the forced inaction of the body, sloughs and renal complications, than to an extension of morbid processes in an upward direction through the cord. Prognosis is, therefore, the best in paraplegia of lumbar origin, not

*Page on the spine and spinal cord. Page 262.

because the rachidian segment of the cord here bear direct violence with more tolerance, but for the reason that such paralysis is generally due to an effusion of blood; which, as it recedes, by a process of absorption, leaves the integrity of the cord undisturbed. The dorsal region is the most exposed. First, because in this the chain is the least movable, owing to the manner in which it is braced on either side by the ribs.

Second, In falls on the shoulder when cervical spine is protected by a downward retraction of the occiput, between the scapulae, the inertia of the lower extremities, in obedience to physical laws, spends itself in the mid-dorsal region.

Third, the cord being rather more superficial here than elsewhere, is more liable to direct violence. Were it not for the pair of pneumatic buffers, which lie in close contact with the spine in the broad lateral costo-rachidian grooves, which by their elasticity and resiliancy receive and scatter moderate concussive force, the cord would be in constant danger in this situation.

Injuries of the spinal cord in the *mid-spinal region*, from falls on the back, when contact is born by an extended surface, are comparatively common. It is usually by indirect force, applied to either end of the trunk, or direct force, acting over a limited area, that the cord is here involved or the osseous framework is exposed to serious damage. But the dorsal region, though taken together in its divisions, is the most vulnerable. It is not equally so in all its parts. Its superior and inferior extremities are the most exposed. In the superior articulation with the last cervical, above the scapular ridges, in the event of falls on the occiput, it is subjected to a great and sudden strain. At the inferior extremity, at the dorso-lumbar junction, when the body is suddenly and violently compressed from above, with the femora flexed on the body, or when the body, while in a state of inertia, is hurled a distance against some solid object, while, with the instinct of preservation, instantaneously acting, we may protect the neck by fixing the muscle at this point.

The brunt of force is met and the spine is crushed, twisted or wrenched, the extent of injury depending on the quality of force applied and its velocity. The greatest convexity of the serpentine curve of the vertebral column is at a point which would nearly correspond with a horizontal line that would pass over the long axes of the scapular spine. Yet even here the costo-spinal convexity of the ribs, the muscular substance and the backward projection of the wings of the scapular on either side, in the event of a fall, first bear the momentum of motion and diffuse it through the trunk before the spine or spinal cord are reached. Hence the reason why, in the event of sudden and unexpected collisions in railway carriages, steamboats or other vehicles, as well as in falls from a height, or in violence suddenly applied to the back, in many the shock of initial contact is propagated forward to a distended viscus, as the heart, stomach or bladder, which is ruptured; or a solid organ is shivered, torn from its attachments or reduced to a pulp within its capsule.

In the application of force of the same quality over the same area, but in a diminished degree, concussive force is likewise spent on the viscera in the cavities before the spine itself is compromised.

The physical quality of this force and its resultant effects are precisely the same, as we witness in those basic fractures of the skull by centre-

coup, or in direct violence, as when the blow first impinges on the vertex; but this escapes injury, while the inferior cranial fossae, with their walls, are shattered, the meninges, brain substance and vessels are torn asunder. We may witness the same phenomena in these basis fractures following falls from a great height and striking on the heels, vulnerant force being transmitted directly through the joints, bone shafts and vertebrae to the supporting surface of the brain.

It certainly is extraordinary that, since we have the "Railway Spine" from collusive concussion, no one has yet ventured to describe the "Railway Kidney," "Railway Liver" or "Railway Hemorrhage;" for both experimental and clinical observations convincingly demonstrate that the spinal viscus is the last to suffer disorganizing lesion and the internal organs the first. Therefore, while the term "Railway Spine" may, perhaps, be permitted to stand in surgical nosology, to be consistent we should also designate all lesions of other organs induced by accident on the iron road as "railway." But it is the general consensus of opinion among surgeons into whose hands these traumatisms first come that there is nothing characteristic about a concussive lesion of the spine sustained by railway collisions and those arising from other traumatisms; that such a condition *per se* does not exist at all; but that when the state so designated is encountered, there are always distinctly pronounced lesions of the spinal marrow, the meninges, blood vessels, contiguous organs and over-lying parts. This will be more fully discussed later.

It is only referred to here briefly, because the dorsal is the region *par excellence* for a spinal concussion. Lesions of the dorsal segment of the cord when of a serious description are almost invariably mortal.

Their clinical features are quite characteristic. The abdominal walls and viscera being mainly innervated by the dorsal ganglia of the cord, with an injury which seriously disrupts or destroys their vitality, we must look for serious derangement in digestion, with a train of characteristic symptoms superadded to all those which are present in lumbar paralysis. In its progress it occupies a middle place with lumbar and cervical injuries. The patient lingers until ascending meningo myelitis sets in, when, with a sudden onset of fever and rise of temperature, it rapidly advances towards and inhabits the reflex functions of the roots of the nerves of respiration. It simultaneously extends into the basic meninges of the brain, hence death is ushered in by a combination of asphyxia and coma, and a convulsive action in those muscles supplied by cranial nerves. The *cervical region* of the spine is that one in which, after direct injuries of the cord or its envelopes, mortal changes must promptly follow. It is also pre-eminently that one in which, too, cranial complications most commonly attend, for the reason that, except in those traumatisms the result of direct force to the vertebrae, the neck is injured by, being caught, compressed and twisted between the heavy trunk above and the head below, the latter invariably sharing in the effects of the violence inflicted.

It will be seen later, in the majority of the cases of serious or mortal injury to the cervical cord which have come under my observation, the injury inflicted was *direct*; and I am not certain but in those reported as attributable to direct force an abnormal motion was also simultaneously propagated to the point of injury.

Therefore, in all but very few exceptions, when the cord in the cervical district has been injured the traumatising impulse is transmitted either through the head or trunk, the neck serving as a hinge. As the spinal cord is the largest in this area, a very extensive injury may be borne by the vertebral structures without the cord being involved. Hence, after partial luxations, ligamentous laceration or fracture, without depression, the implication of the spinal marrow is often consecutive only. The neural and vascular supply in the soft parts overlying this segment of the cord is more abundant than in any other. It is, practically, the respiratory center of the spine in its center and superior half. Therefore, in all violent injuries which involve great compression, stretching and torsion of this immense mass of muscles, these will always occur preliminary to cord implication, when we will encounter a free and diffused hemorrhage into and through the inter-muscular spaces, with subsequent inflammation, rigidity, tumefaction and discolored areas of integument. From the extensive injury to the numerous network of nerves a painful neuritis follows. And accordingly, to prevent movement, the articulations are locked and the head fixed, sometimes in a position of extreme tension, laterally or flexed, on the sternum. Pain is reflected along the nerve filaments which spread along the thorax anteriorly and posteriorly, over the shoulders, the deep and superficial areas of the neck itself.

Besides the above clinical phenomena attendant on and characteristic of cervical injury of a grave description, as the effects progress we will notice that respiratory movements become embarrassed, irregular and painful. Mucus accumulates in the trachea and bronchi, and the efforts made to dislodge it are painful and futile. But, unless the lesion of the cord extend up to the fourth and third vertebrae and involve the roots of the phrenic, the diaphragm, which, in the male, is the principal muscle of respiration, will do the work of keeping the lungs in motion. Now, as the reflex centers of the phrenic are attacked, unmistakable signs of impending asphyxia present themselves. The imperfect aeration of the blood imparts a deep, dusky tinge to the exposed integuments. All the accessory muscles of the neck are called into action and the shoulders rise high, in spasmodic jerks, with each gasp. Were it not for a most merciful provision of the economy at this stage, our patient must present a truly heartrending spectacle in his struggles for breath. But, happily, in this unfortunate class, for many hours before the end comes, simultaneously with this *spinal-asphyxia* and implication of the phrenics, we have symptoms of the brain being involved. The muscles of the eyeball begin to twitch, the pupils contract, consciousness is lost and delirium sets in. As a rule, in all cases of fatal traumatism of the spinal cord, when symptoms of ascending meningitis unequivocally declare implication of the respiratory centers, the patient seldom survives twenty-four hours.

Finally, we may repeat that traumatic lesions of the cervical spinal cord, *per se*, are the least frequent, run the most rapid course and commonly end in death.

THE ROLE OF HEMORRHAGE, FRACTURE AND INFLAMMATION IN TRAUMATISM OF THE SPINAL CORD.

Hemorrhage within the vertebral canal is a most common and fruitful source of pathological changes inducing temporary distraint, trophic wasting vaso-motor disturbances, paresis, paralysis, local, circumscribed or ascending meningitis or myelitis.

Spinal haemorrhage presents various types. The most common and least harmful is that which is *outside* the theca-vertebralis, *extra-dural*. This was the phase of hemorrhage which was observed by me, in nine out of the fifteen cases in which *post mortem* examinations were made and notes have been preserved.

The next in order of frequency is rachidian-meningeal; a mixed type.

The third, and last, least frequent, as an independent factor, is meningeal, or extravasation from the vessels into the arachnoid and pia-mater.

Some neurologists regard hemorrhage into the medullary substance, "haematomyelia," as a result of injury to the spine. But inasmuch as there is no proof of this lesion as a *primary* condition as revealed by *post mortem* demonstration, something more than a mere theoretical assumption must be forthcoming to support it before it can be admitted into the category of independent spinal lesions.

In a short essay recently presented before the section on neurology at the New York Academy of Medicine ("A Few Clinical Notes on the Usual Situation of Spinal Hemorrhage," April 2d, '93), I endeavored to refute the theory of primary hemorrhage into the medullary substance of the spinal cord as a consequence of trauma; and showed, by an injected specimen, that there are no vessels visible to the naked eye in it (in the medulla) and that it derived its nutrient supply through a delicate reticulum of capillaries, given off from the pia-mater and those branches of the vertebral arteries which descend laterally and through the intervertebral notches from the intercostals.

At this stage of our study it may be appropriate to cite the observations and reports of a few authors on this subject of spinal hemorrhage and comment on the conclusions arrived at.

Hammond, in his latest edition on "Diseases of the Nervous System," says (p. 406) under the head of "Signs of Spinal Hemorrhage," that there is always in spinal hemorrhage loss of mobility. This is entirely at variance with my observations; even in those in which confirmation of *post mortem* examination was permitted. The same author cites a case of this lesion in which large sloughs, over the gluteal and sacral regions, occurred within six hours after injury. In one case a clot was found in the substance of the cord, extending from the tenth dorsal to the fifth lumbar vertebra. Prof.

Hammond says that death is the usual result in spinal hemorrhage. The favorable termination in the majority of our cases of spinal hemorrhage certainly fails to support this assumption; and, judging *a priori*, there is no reason why this should be the case in a hemorrhage into the membranes of the cord or its parenchymatous elements, than into the brain or the parenchyma of any other organ. The fact is, in spinal hemorrhage, the untoward results are rather dependent on the simultaneous injury of other internal organs and disorganization of the spine itself than on the presence of hemorrhage *per se*.

Clark (Surgical Diagnosis, London, 1870, p. 146) reports the following case of spinal hemorrhage. Patient a man of 150 pounds weight was "tipsy" and fell on the sidewalk. He fell on his hip and side. On attempting to rise he fainted. Then he discovered that he had lost power of his legs and over his anus and bladder. He remained four months in the hospital and finally left with power over locomotion. (It is very probable there was fracture here, too.)

Hammond, under the head of "morbid anatomy and pathology of spinal hemorrhage" (p. 411) says that extra-meningeal hemorrhage is usually the result of trauma; and that it is circumscribed and limited in extent. The cervical region is, he says, the most common situation, the lumbar the least. Heyem is cited as having published fifteen cases of spinal hemorrhage, of which in three it was extra dural, eleven were intra arachnoid, and in one it was sub-arachnoid.

Grisolle says that spinal hemorrhage runs a rapid course (Grisolle, Path. Internal. Vol. 1, p. 659). Wilks alleges that he has never seen a case of spinal apoplexy without injury. (Wilks' Diseases of the Nervous System, p. 202.) *Page, Diseases of the Nervous System, calls attention to what he designates "Erichsen's form" of extra-theal hemorrhage following blows on the spine. Kirmisson (Traite de Chirurgie par Reclus et Duplay, Vol. 5, p. 303), accords to spinal-hemorrhage a subordinate position as a predominant lesion, consecutive to traumatism. *Mansell Moullin says that the spinal cord may be injured without the spine being compromised. Haematomyelia or hemorrhage into the medullary substance is nearly always the result of forced flexion; and that the sanguinous extravasate is most enormous into the white substance because this is the most vascular part. Dana says the gray substance is the most vascular. Liddell (Encyclopaedia of Surgery, Sect. on Spinal Traumatism) cites Dr. John Cranes' case, in which a man was thrown, thereby seriously injuring his spine and inducing paraplegia. After death free extra-dural hemorrhage was found. Brown-Sequard (Sydenham Soc. Year Book, 1859, p. 41) makes the statement, that in spinal-hemorrhage into the cord, it may be distinguished by the gradually decreasing sensibility, with no convulsive action in the muscles; while in the extra-theal which compresses the nerve roots there are convulsions and paralysis of voluntary motion. It does not appear that these allegations of the distinguished physiologist are based on surgical observations, and they certainly are in no manner supported by my own observations on the human being. In Askurt's valuable contribution on spinal injuries, due importance is given to hemorrhage in spinal lesions, but this eminent author does not support the views enunciated by Sequard.

*Mansell Moullin Sys. of Surg., p. 614.

Thus it appears that spinal hemorrhage is recognized as a common sequela of serious trauma.

Anatomically, spinal hemorrhage occupies a peculiarly unique position. To use a paradox, it occurs within a cavity and yet, in the vast preponderance of cases, its precise position is outside of one. We speak of pleural, abdominal or brain hemorrhage, when it is understood that the extravasate is within a serious cavity. The same impression had formerly prevailed in the profession with respect to spinal hemorrhage. As the most vascular districts are about the articulations and the loose connective tissue outside the theca, here the most abundant effusions are met, and here, too, in those of sound constitutions, in the absence of extensive complications, this excessive vascularity also aids in the prompt resorption of what it contributed to form.

When it is distinctly borne in mind that spinal hemorrhage is generally outside the serous cavity of the arachnoid and is nowhere in contact with it, we can understand why there is little analogy with the attendant consequences and those dependent on a leak into the cavity of and over the surfaces of a serous membrane. The irritating action of the liquor sanguinis not infrequently excites a peritonitis, pleuritis or meningitis; but never in spinal hemorrhage, unless the external extravasate is voluminous. Hence as an aetiological factor spinal hemorrhage, extra thecal, when the source of consecutive changes, plays role peculiar to itself. For, while with other types of hemorrhages here cited inflammatory or other changes are mainly dependent on irritation; here pressure alone suffices to stir into activity those mutations consecutive to mechanical compression.

The clinical phenomena which follow hemorrhagic-compression or disorganization of the cord, will be present in strict accordance with certain anatomo physiological conditions; though it must be admitted that in its minor phases, it is quite impossible to determine its presence or be apprised of the situation of the effusion by peripheral palsies, or diminution or exaggeration of the reflexes, etc. The extent of spinal apoplexy will be determined by the rapid spread of peripheral paralysis. For instance, in those cases in which there is a rapid ascension of the paralytic line, where chill has occurred, there is acceleration of the pulse, with rise of temperature. In the present state of our knowledge, in a general way, it must be conceded that we are acquainted with no symptoms which definitely point to either *intra* or *extra* dural hemorrhage in all cases. Its location on the contrary, must be inferred by exclusion and attendant or precedent circumstances rather than by a definite symptomatology. It may, however, be stated that, as a rule, in all injuries of the spine not attendant with fracture or dislocation the seat of hemorrhagic effusion is most commonly *exthecal*. Although this view is not in harmony with those promulgated by certain authors, it is agreed to by the majority; has the confirmation of our experimental investigations and is in keeping with a surgical law, viz.: *that in all injuries of a structure or organ, the peripheral parts as a rule, are the first to sustain disorganization, and the central last.* For a long time it has been observed that in many of the cranio-rachidian injuries resulting from violent falls or blows simultaneously borne by the head and neck, in which the vertebrae have escaped, the hemorrhage resulting has been of the *intra meningeal* or *intra-medullary* type; the escape being

primarily from the larger trunks at the base of the brain, thence descending within the theca through foramenmagnum into the cord.

There is no manner in which we can account for the confused and contradictory views of authors on the question of location of hemorrhage within the spine; except by assuming that *post mortem* examinations on the parts have been indifferently performed. Certain it is that until comparatively recent times since the utilization of steam as a motor power the construction of very high buildings, concrete or paved streets and sidewalks, the use of dynamite and giant powder in blasting, mortal or violent lesions of the spine were very unusual. It may be added, too, that, as the spinal cord is the most inaccessible organ in the body and very difficult to expose on autopsy without damage, unless the examination is made by an adept, on opening the spinal canal the pathological findings will, indeed, be of very questionable value. It has been said that the pathological changes following spinal hemorrhage depend on two physico vital causes:

First—Compression.

Second—irritation, or irritation and compression.

One might suppose that an organ so well protected as the spinal cord, with its firm lateral and longitudinal braces and dense, resisting envelopes, would possess great resisting power to hydrostatic pressure. But the compressing power of escaping arterial hemorrhage is enormous at times, and, added to it, the results of gravitation on fluids everywhere found combine to make its effects on an organ very disastrous.

When we see, in case of pulmonary-hemorrhage, the healthy, elastic lung caught and crushed up into a mass no larger than an orange, in the supra-clavicular space, the heart displaced and motion in the healthy lung on the other side greatly embarrassed, we can appreciate what this force is. A cerebral hemorrhage, of sudden onset and large volume, will split and shiver the brain substance in every direction. But hemorrhage, to affect the cord, must be arterial and from a vessel of considerable size. In all the *post mortem* examinations which have been made by me, in which a large hemorrhage was found in the spinal canal, the blood was of a light florid hue, coming without doubt from the lateral rachidian arteries, which are in the dorsal region branches of the intercostals which wind around and make their way inward through the intervertebral notches or foramina. It is rational to assume that in this district, however, the phase of hemorrhage most common in recoverable cases is venous; for the rachidian plexus is an exceedingly vascular network of large thin-walled vessels. But the circulation through this plexus is in an air light compartment, the spinal canal, or vertebral hollow, and must necessarily be languid. In fact it is stated by physiologists that these vessels are only emptied by the suction power exercised in respiration through the emulgent intercostals. Therefore, we can understand why, when there is a leak from one of them, as in any of the peripheral veins, the resistance of adjacent parts prevents its advance and limits its spread. Accordingly, this hemorrhage, while it may stuff a certain segment of the vertebral canal, being destitute of the attributes of that of arterial origin, it is limited in quantity, devoid of great compressive force and is not attended by that marked anaemia so common in arterial loss.

Intra dural hemorrhage from traumatic causes is not common, and when of sufficient volume to give rise to marked disturbance of function is

usually only as a coincident condition to extensive lesions of the overlying parts. As an independent primary lesion after injury, according to some authorities, it is said to occasionally occur. But such cases are very rare. When the bleeding spreads between the arachnoid and internal surface of the dura mater it may extend outward along the nerve roots on either or both sides of the commissures. When it occurs over but a limited area, it may be partly absorbed without any more than a local neuritis following. In a considerable number, meningeal inflammation will be in proportion to the extent and situation of hemorrhage. It is enough to repeat that there is no proof of any description whatever, from a surgical standpoint, that such a lesion of *itself* can occur as a consequence of truma. Traumatic primary hemorrhage into the meninges of the brain and brain substance is commonly seen. But from cogent and self evident reasons, based principally on the difference of physical conformation, it is evident that it must be a very rare event in the meninges or medullary substance of the spinal cord.

The most serious and frequent pathological sequence of an extensive spinal hemorrhage into the spinal canal are meningitis and myelitis. The spinal meninges are extremely intolerant of severe and protracted pressure. My observations have been that if the symptoms of paralysis, which immediately follow a large hemorrhage, do not abate within six or eight days, meningitis almost invariably develops. And with a few exceptions, after fever is once well established and the temperature mounts up to 100 it cuts off life within four or five days; always steadily advancing upwards until the vital centers are reached.

Spinal-myelitis, medullary degeneration or softening, cannot be said to occur as a *primary* condition after spinal injury, except in those cases in which the crushing effect of disorganization are immediately borne by the cord, as in fractures punctured wounds, etc. If we concede primary hemorrhage as a possibility into the cord substance, then we must regard myelitis as a very common result of spinal injury. In that event it would be as reasonable to expect softening to follow apoplexy in the spinal cord after injury as in the brain; though let it not be forgotten that even in the brain itself softening as a direct consequence of traumatic hemorrhage is a most unusual event. Spinal myelitis then, when it develops in consequence of injury, is chiefly dependent on two factors.

First—Direct crushing force on the marrow itself.

Second—As a secondary condition, when it occurs in consequence of vaso motor disturbances and nutritive changes consecutive to a pre or co-existing meningitis.

It has been alleged that it arises as a primary condition after injury from hemorrhage, inasmuch as a free hemorrhagic extravasate is often found internally incorporated with the ganglionic cells and fibers. But here it is evident that the diapedesis or extravasate of the red corpuscles, one of the ordinary and necessary phenomena in the evolution of inflammation, has been mistaken for a primary hemorrhage. Red softening of the cord is pathologically similar with pulmonary consolidation. It differs only in that it ends in the destruction of the part in which it is situated.

LESIONS OF THE CORD COMPLICATED BY, OR IN ASSOCIATION WITH INJURIES OF THE EXTREMITIES.

In my experiments on the spines of cats it was frequently noticed that the humeri and femora might be dragged out of their sockets without making any impression on the spinal column.

May not the spine by the same force which causes a dislocation or fracture sustain injury; or in other words, is there in these fractures of the limbs induced by collision or other force necessarily any tendency to very serious implication of the spinal medulla? There are clinical data to support such an allegation, though few. On the contrary, the evidence strongly inclines the other way with few exceptions. In support of this view, I may here in abstract cite a few cases which came under my own care or knowledge.

A man was brought into my service at the Harlem hospital two years ago, who was caught in a belt, dragged up over a shaft, crushed between it and a beam and thrown about twelve feet. Both knees were torn out of their sockets. (Case reported in *Buffalo Medical Journal*, December, 1891).

Although both limbs perished in a short time from gangrene consecutive to injury of the popliteal vessels, except below the joint at which point the nerves were damaged, there was no paralysis in the thighs or the least evidence of spinal injury.

The force necessary to dislodge the femur or fracture its shaft in the healthy adult is always very considerable; yet paralysis or evidence of serious organic lesions of the spine is seldom seen in these cases. Last summer ('92) a young woman was brought into my service, who was caught in a shaft moving at the rate of 500 revolutions a minute. Her right arm was torn off her body in an instant close to the shoulder joint and she was hurled several yards with great force. She made a prompt recovery, without at any time manifesting the slightest trace of cerebro-spinal or spinal injury.

In August, '84, while in charge of the Ninety-ninth Street hospital service, an Italian was brought in by the ambulance who had both his arms blown off close to the elbow joint and his body was blown many feet into the air by a premature blast of dynamite. He had few spinal symptoms, though the physical conditions were the ideal for so-called concussion. But the portio-mollis sustained only trivial injury, neither at the time of accident nor since; for I now see the poor fellow occasionally, who makes a living by grinding a hand organ with an artificial attachment fixed to the elbow on one side.

In considerable number of railroad smashes of the extremities on steam and tram railways many entailing amputations, spinal complications are very unusual. The most serious lesions concomitant with this class of fracture are those which involve the brain or the internal organs of the trunk.

In more than three thousand severe cases of fracture and lacerations which have come under my care during the past twelve years there were but few in which as an integral part of the injury, at the time of the fracture, the spinal cord was directly involved.

Ten years ago a near, dear relative of my own was terribly mangled by a most extraordinary accident. The unfortunate creature was first caught between the front of the locomotive and the depot wall, and in a moment the floor and timbers gave way, when she, the locomotive and all, went into a cellar 14 feet underneath. When she was removed from the *debris* she was alive and survived in terrible agony for four hours. Dr. Irish, of Lowell, coroner's examiner for Middlesex county, Mass., made the *post mortem* examination. He discovered the thorax terribly crushed, the lungs, liver, stomach and kidneys torn in every direction. The spinal cord was not examined, though the Doctor informed me that she could freely move her lower limbs and there was no paralysis.

Thus, it is a demonstrated fact that the peripheral nerves may be torn out at their roots, joints disarticulated, limbs shattered, mangled or subjected to every conceivable force, and yet that marvelous encasement of the spinal cord so effectually protects it that it most frequently escapes injury. In those cases of dislocation at the shoulder-joint, or in any other injury in which there has been great torsion or contusion sustained, and paralysis, either temporary or permanent, follows, it should be remembered that the pathological condition is confined to the nerve trunks, beyond their points of emergence from the theca-spinalis; and that ulterior degenerative changes observed in the cornua or cord ganglia are attributable to functional inaction and not to primary trauma.

Hence it is only when the entire body has suffered great violence in association with injuries of the extremities that either primary or consecutive paralysis may occur in cases of trauma.

SPINAL INJURIES, IN WHICH ECCENTRIC LESIONS PREDOMINATE.

At the beginning of this study it was clearly emphasized that with the exception of uncommon and unusual cases the spinal marrow cannot suffer a positive organic lesion sufficient in extent to curtail or inhibit function without simultaneous injury to its curved, bony hollow, the one

osseous, arthritic, ligamentous, tendinous, muscular, connective tissue and tegmentary envelopes; besides, frequently, the peripheral nerves. The converse will not, however, hold good. This is of importance to remember, in medico-legal cases as well as from a therapeutic standpoint. It might be argued that after certain injuries to the back, from collision or otherwise, that, inasmuch as there was no evidence of organic change in the cord, either of a temporary or permanent nature, no serious impairment to strength or movement could exist. Again, if in the treatment the surface, peripheral character of the lesion was not clearly recognized, much harm might occur through omission or commission in overlooking the affected areas and in directing our therapeutic resources toward the spinal cord, the integrity of which might not be disturbed at all. Traumatic vertebral-arthritis, synovitis, central cellulitis or multiple peripheral neuritis might either alone, or in a mixed form, be mistaken for disease of the medullary substance of the cord. Here these lesions have been purposely grouped, for the reason that many cases which belong to this classification have come under my observation and treatment, which in several instances had been designated "spinal disease," a term which, to many, has a very serious significance.

Considering lesions of this description may seem a digression or a drifting away from the subject proper; but, inasmuch as the cord has formerly been held responsible for them, it has seemed to me imperative that their independence of medullary lesion should be distinctly accenuated. Very much might be said with advantage under this head, for they constitute the most numerous of rachidian-injuries, but limit alone of space, and the restrictions imposed by the title will prevent it.

MIXED CASES, ENCEPHALO-SPINAL.

Bearing in mind the anatomical relations of the brain and spinal cord and the knowledge that the bulbar enlargement of the cord, the medulla oblongata, is wholly within the skull and rests by its inferior surface on the basilar-process of the occipital-bone, we can readily see that a lesion of the cord or of the brain exciting inflammation in the parts contiguous to each other must necessarily involve both. Hence in all extensive fractures at the base of the skull the spinal cord is invariably involved, and why, in general cerebral meningitis, pathological processes spread in a centripetal direction, into the cervical segment of the cord, and, conversely, why, in spinal meningitis, or hemorrhage in severe spinal cases, the base of the brain in time is invariably implicated.

But what is particularly referred to at present are the cranio-spinal injuries, the consequence of simultaneous violence, as after falls, blows or collisions, when both brain and spine are injured at the same time. The most common type of these injuries is seen after falls, in which the head and back, chest or shoulders bear the brunt of force. Many such cases have come under my observation in the hospital. If the patient is not in a comatose condition on entrance he will complain of severe pain in the neck and keep the head fixed. We will find contusions of the scalp and occasionally, under it, large haematomata.

In the young, or those in early life, in whom the bones of the skull are yet elastic, and whose corporal development, the emboupoint or adipose growth, so often seen after the meridian of life is reached, the effect is less, when the body is projected headlong; and the cervical segment of the vertebral column and spinal cord in the corresponding parts sustain injury oftener than the brain. Hence why we so frequently meet those cervical lesions in swimmers, who, in making a plunge into the water, in the act of diving, strike the vertex in a shallow place where the water is not of sufficient depth to reduce momentum, and the weight of the body is borne by the head and neck. In other similar injuries the same results will be observed.

It is my conviction that in many of those cases of spinal injury in which tachy cardia, disturbed respiration, with disorder of the special senses, occur, the brunt of force has been spent on the neck and base of the brain. These phenomena were observed in nearly all our cases of this description which ended mortally, though their presence was generally but transient. I have known but one case in which these symptoms lingered more than a month after injury.

CASES OF SPINAL INJURY IN WHICH FULL FUNCTIONAL POWER WAS REGAINED.

The common rule in spinal injuries which involve the cord to such an extent as to cause complete paralysis or trophic changes in the distant parts is that the cases go on from bad to worse and sooner or later end fatally, rarely, if ever, running in their course over three months; or else the patient regains full functional power and entirely recovers.

The first class may be best considered in two divisions.

First—Grave cases in which primary ascending meningitis promptly leads to a fatal termination.

Second—Those in which the local destruction of the cord at the seat of injury is complete, but the location is low down, away from any vital centers of the spine, as in the lower dorsal or lumbar region.

In these paraplegis, though none of the vital functions are directly disturbed at first, they soon commence to suffer through a propagation of pathological conditions and constitutional disturbances. The inanimate regions, cut off from the vitalizing influence of the nervous system, as now only the communicating cutaneous filaments are intact, soon show signs of atrophic changes. The constant involuntary discharge of the faeces, with the incessant pressure from dorsal decubitus, soon cause large, deep, gluteal and sacral sloughs. The limbs become oedematous and cool, with such feeble resistance to trauma or friction, that the most trivial pressure, in certain places, will cause sloughing. In time absorption of these foul, infectious discharges give rise to septicaemia. But, perhaps, most often, with these life is cut off through renal complications. The bladder, unable to empty itself, must be periodically drained—it must be catheterized. But the repeated introduction of a catheter will give rise to cystitis, and this, in time, to amoniacal decomposition of the urine, a septic nephritis and ultimate suppression.

With those whose restoration to health has been complete recovery has been, as a rule, prompt and permanent. In lingering cases recovery is generally retarded by two things. First, internal complications; second, constitutional dyscrasia or cachexia, as malaria or rheumatism, tubercle or syphilis.

CASES IMPERFECTLY RECOVERING WHICH RUN A CHRONIC COURSE.

Cases of injury to the spine of an extrinsic character which are attended with laceration, fracture, hemorrhage into the soft parts, consecutive inflammation with limitation of motion or ankylosis, make slow progress. And aggravated cases must necessarily leave some impairment in motion and strength, a condition, perhaps, analogous to that following the fracture or any severe injury of a limb; in which, though in the average case, we may dismiss as cured, still perfection in function cannot be said to have been attained. In malarial districts, in lingering cases with intermittency of fever, we may rather attribute chronicity to this lethal influence than to local pathological conditions within the cord. Rheumatic arthritis must be suspected in the majority of cases in middle-aged or old people. The surface hyperesthesia, pain on motion, myotrophic changes in the soft parts, so mimic real spinal injury that in chronic cases in order not to confound a constitutional dyscrasia with a local traumatic condition of the cord, we should rigorously investigate the patients' antecedent, personal and hereditary history; examine the other joints of the body, the cardiac structure, etc. Syphilis or tubercle may find lodgment in the rachidian structures and protract, greatly delay or prevent recovery after traumatic damage to the spine. Tubercle plays its *role* in the osseous structures and affects the cord, chiefly by mechanical pressure. Clinically, it is interesting to note that primary tubercular spinal meningitis is a disease practically unknown to pathology. The condition of the lymphatic glands, the osseous changes and the distinctive clinical phenomena which accompany rachidian phthisis are generally so clear and characteristic that a traumatic lesion is not apt to be confounded with it.

With a syphilitic individual, however, the subject of spinal trauma, it may be quite impossible, by any means whatever, to definitely determine the extent of disease of the cord, dependent on trauma, and that attributable to the action of venereal virus. But tubercle usually spends its energy on the bony envelopes, while syphilis confines its ravages to the cellular and parenchymatous elements of the medullary substance. In the presence of a case in which syphilis is suspected, in the absence of other aids, much light may be shed on the case by an examination of the organs or structures for which syphilis seems to manifest a special predilection. No cases of the latter category have up to the present come under my observation, though some have been recorded in recent times by various authors.

INJURIES OF THE CORD TREATED BY DIRECT SURGICAL INTERVENTION.

Experimentation has opened the way to a clearer appreciation of the precise morbid anatomy and the pathological changes consequent on spinal injury. It has been demonstrated that the concussive force necessary to directly disorganize the cord or its membranes must always be very great; that in such lesions rupture of the vertebral ligaments, partial luxations, fracture of the spine or damage to an internal organ are almost inevitable concomitants. But, unhappily, in the way of treatment experimentation has lent us no aid. It is unnecessary here, nor does it come within the scope of this review, to quote cases, give statistics or the results of operative measures in injuries to the cord in modern times, by improved methods in operating, as it is enough to know the mortality attending them is very great.

Theoretically, however, it would seem that in these cases of hemorrhagic or bone pressure the tissues should be divided, the blood removed or the fragment of displaced bone lifted out. But the spinal cord is exceedingly intolerant to atmospheric irritation and to digital manipulation, more so, perhaps, than any other organ in the body; certainly very much more so than the brain. Besides it is altogether much more inaccessible to more so than the brain. Besides, it is altogether much too inaccessible to operative manipulations than this organ; therefore we need not wonder why surgeons who have to deal with traumatic spinal lesions, with the large mortality record in mind and their own personal experience, shrink from opening the spinal canal after lesion of its contents. Perhaps a general knowledge of the direful consequences so common after trephine operations is why the authors of text-books on surgery give this procedure, and others, of a kindred type, little or no notice, and we can learn practically nothing in them on this branch of surgery.

Although as many as nine or ten cases of fracture of the spine (?), or, more properly, fracture of the apophyses the spinal process, have come under my care, but two was treated by operation—one in the cervical and one in the dorsal region. It must be said that neither was relieved in the slightest degree, both ending mortally. In the last case my impression was that my patient's chances were rather diminished by the operation. Any one who will for a moment compare the anatomical difference in the situations of the brain and the spinal cord will at once perceive what is the fact, viz.: That there is almost no analogy between the surgery of the brain and spinal cord.

INTERNAL INJURIES AS A COMPLICATING ELEMENT IN SPINAL INJURIES.

In Dr. Watson's experiments on the spines of dogs it does not appear that there were any serious cranial injuries. But that the brain did not escape entirely is evident from the fact that he makes note of certain ocular phenomena. With the dog, whose brain is to the weight of the body relatively very much lighter than in man, we might expect it would less frequently suffer lesion in falls. It appears, however, that in all cases in which the spinal cord was crushed there was simultaneously serious damage inflicted on the internal structures. In most cases, when the vascular apparatus suffered there was internal hemorrhage. In the thorax and aorta was ruptured and the cardiac walls sundered, the pleura torn or the lung opened. In the abdomen, hemorrhage was also common with or without rupture of an organ. Here the kidney seldom escaped laceration; the stomach, bladder and liver were ruptured. Some, indeed, there were who suffered fatal injuries, besides those mentioned that died without the spine being involved at all.

Practically, the same phenomena are observed in man when the spinal cord sustains a disorganizing lesion from concussive force. In the cases which ended fatally under my care, and *post mortem* examinations were permitted, it was only in a certain portion of them that the abdominal viscera was examined. This was because in some we were restrained by the friends and relatives and because the spinal were the predominant symptoms and we, thoughtless, sought only the organ from which the symptoms emanated.

As far as my experience goes the organ which most frequent suffers in spinal injury in man is the kidney. Persistent and exhaustive haematuria is not an uncommon symptom in those injuries which involve the lower dorsal or lumbar regions.

One young man in my hospital service, mortally injured in the spine by railroad accident, had such an enormous escape from the meatus urinarius of bright arterial blood that the house surgeon, thinking that it came from a laceration in the deep urethra, and fearing that the patient would bleed to death, stuffed the lumen of the urethra and firmly bandaged the penis, though the only effect was to over distend the bladder.

Certainly when the heart's action is diminished in power by exsanguination the blood escaping in feeble jets coagulates and finally ceases of itself.

It has been said by not a few that since the advent of the modern gynaecologist a woman has nothing but a uterus. Many seem to assume a similar illogical inference in injuries from collisions that nothing can be injured by the "spine." It must be "injury of the spine" or nothing when the trunk is involved. But not infrequently while one is waiting for a financial reimbursement, after an injury caused by the neglect of an individual or corporation this "spinal injury" is not infrequently the evolution of the most consummate strategy; for the patient seems to instinctively know, what is a well recognized scientific fact, viz.: that of all the organs in the human body there is none so devoid of tangible, physical, objective symptoms when injured as is the spinal cord. The tricky, crafty, imposter knows better than to claim serious injury to his kidney, lung or liver for he seems to understand that these organs when seriously compromised impart unerring physical signs which cannot deceive. It is well, however, to always remember in grave injuries of the spine at the time of our first visit and for a while thereafter to scrutinize our patients' general condition and look carefully for visceral injury. For while he may safely survive a contusion of the back the unrecognized and untreated injury of a viscus may destroy his only hope of recovery.

In one case of this class in which our patient constantly complained of great pain in the hypogastrium on entrance it was only on the third day, with the appearance of icterus and great distension of the abdomen, that we suspected rupture of the gall bladder. He was tapped and two gallons of oily gall removed. He succumbed on the fifth day, when a rent about four centimeters long was discovered running horizontally across the base of the gall bladder.

CONCUSSION OF THE SPINE—RAILWAY SPINE—SERIOUS FUNCTIONAL DISTURBANCE OF THE SPINE, WITHOUT INJURY TO ADJACENT PARTS.

The underlying fundamental purpose of Watson's experiments was to determine the possibility of inducing in the lower animal a condition analogous to what has been designated in man as "concussion of the spine" or, later, "Railroad Spine." But in vain did this enthusiastic and indefatigable investigator labor, for he found as an invariable result in every case that "the symptoms succeeding injury to the spinal cord were in exact proportion with pathological lesions." In other words, that there was no such independent lesion as "concussion of the spine" *per se*. But there have been several cases recorded by surgeons of impeachable veracity and of eminence in the profession of what they regarded as such disordered states which should come under this description. And so do we find in text-books on surgery, that condition described as "concussion of the brain." Many a candidate for honors in hospitals and other examinations has come to grief because he could not define to his examiners satisfaction, the signs

and symptoms which should distinguish this condition from compression of the brain. But the tendency of modern authors is to altogether ignore it or give it a very subordinate position in the nosology of spinal traumatism.

My own observations now have extended over 250 cases of serious cranio-cephalic traumatism, in more than 150 of which there was fracture; and I cannot truthfully say I have ever seen a single case of brain disturbance that could be attributed to a mere shaking up of the brain substance *commotiones de molle*, without a lesion somewhere being discovered in the central or investing parts. As this subject of concussion of the brain has a most important bearing on the phenomenon designated "spinal concussion," it is most important to here note what modern experimentations and observations have contributed in support or refutation of the so-called "cerebral concussion." The latest and fullest contribution on this subject has been presented by Dr. Charles Phelps of New York (A Clinico-Pathological Study of Injuries of the Head with Special Reference to Lesions of the Brain Substance." New York Medical Journal, Jan. 14th, 25th and 31st, '93).

In this article Phelps reports 124 cases of serious cranio-cephalic lesions which were treated by him during the two preceding years. He takes strong grounds against such a lesion as concussion of the brain substance, and cites in support of this attitude the testimony of Prescott Hewitt and von Bergman. In the series of cases he cites there were fifty-eight deaths, with as many *post mortem* examinations. In every instance he alleges that he was able to find on autopsy sufficient pathological lesion to account for death. It seems that he substitutes the term *contusion* for concussion; as in the mortuary column he sets down eight deaths from general *contusion* (of the brain) and eight as meningeal *contusion*. It does not appear that in these sixteen cases, or in any others (the 108), that there was an examination made of the contents of the thoracic or abdominal cavities. But it is clear to any one that a part so exposed as the head is liable to violent commotion in the event of sudden and violent jars expended directly on it, and that the contents of the skull may suffer disorganization, without its bony encasement being at all damaged. This, Phelps does not deny; but he denies a symptomatology without a corresponding cerebral pathology, and hence in all mortal cases, in which symptoms of compression were absent, but formerly recognized as concussion, sufficient *contusion* of the membranes and parenchyma of the brain was discovered to account for death. It would have been of great interest had Dr. Phelps given the ultimate results in those cases of brain *contusion* which passed from under his care when they left the hospital. It is then generally conceded that we may have serious or moderate cerebral disturbance without extensive lesion of brain substance by compression of bone or hemorrhage. But it is irrational and fallacious to assume in all cases following severe bodily injury attended with cerebral disturbance that the brain has suffered trauma: for a violent fall on the back or abdomen may immediately kill, induce ecma or convulsions when the head has entirely escaped. The common error is committed when patients are admitted to hospitals in assuming that because cerebral symptoms predominate, the brain *alone* has sustained injury. Reasoning from analogy, it must be supposed in those cases of severe injury to the back in which there is no fracture or evidence of grave lesion of the cord the term "concussion of the spine" has been adopted. This is the generally accepted definition of those cases of traumatism of

the spine from concussive force, in which the cord sustains damage without fracture of the vertebrae.

Watson's experimental and clinical observations are in entire accord with the experience of the vast majority of hospital surgeons and with my own researches; and all are in quite general accord that there cannot be a morbid condition of the spinal cord following accident which constitutes a specific entity without disorganization of overlying or adjacent structure.

Modern scientific investigation has shown that in the majority of those spinal cases commonly set down as concussive the dominant lesion has been hemorrhage; haemato-meningea, haemato-myelia or haemato-spinalis. It has been demonstrated also that meningeal irritation or inflammation is often dependent on sanguinous effusion, and that in those cases of this description the termination is toward death or permanent recovery. It has been found, too, that a mortal hemorrhage is rarely seen except when complicated by fracture.

But the ground on which the theory of concussion rests is that in sudden collusive shocks to the body the central molecular elements of the cord suffer serious disturbance which ultimately lead to organic changes; that these reveal themselves later by certain definite and characteristic symptoms in the form of localized palsies, anaesthesias, hyperaesthesias, neuralgias, psychical disturbance and implication of the special senses. There can be no question, but in all cases of severe concussive violence to the body every atom and fibre of its composition feels the vibratory thrill, suddenly expended on its substance. But on what law in physics does the claim rest that the best protected organ of the economy can suffer the disintegrating influence of shock, while other much more exposed, friable viscera entirely escape, has not been explained. On the contrary, as the work of scientific investigation proceeds, the horizon becomes cleared and now what heretofore had been obscure has been stripped of the mysteries which encompassed it.

Ferrier, Horsley, McEwen, Keen, Dana and others have demonstrated that the brain cortex is the center of motor and sensory areas; from which we must infer that in many of those cases heretofore described as of spinal origin are after all entirely encephalic. Accordingly, we are beginning to hear of "ataxic palsies of cerebral origin, cortical neuralgias and focal epilepsies. We are told that concussion of the cord may be distinguished from compression by the symptoms being rather general than local, and passing off from a few minutes to several days or hours.

Gull, in Guys hospital, reports a case which had been diagnosed as one of pure spinal concussion, but in which, after death, fracture through the fourth cervical vertebra was discovered with a large extra-theal hemorrhage. Herbert Page ridicules the idea that there is anything characteristic in a railroad injury of the spine. Charcot has shown that in the hypnotized light blows on the body will produce anaesthesia and localized paralysis. If this is the rule in this class is it not rational to assume that during the momentary frenzy of terror which seizes on one in an impending or actual railway collision that but a slight blow or fall might induce paralysis? Erichsen observed that those crushed in the sleeping berths of a railway carriage more often escape subsequent spinal symptoms than others who were about awake. This statement clearly points to the preponderance of *psychical* influence over primary, material, organic phenomena, in spinal injury. Charcot (Lecons sur les Maladies du System Nerveux.

t. 111, p. 271) claims for railroad injuries of the spine no other *role* than such as are observed in those injured by other causes who are predisposed to organic and functional disorders of the nervous system. Hence, why he designates them "hystero-traumatisms." He adds that the reason why they are more often observed in men than women is because they travel more; that the deafness, disordered vision, dyschromatopsia, convulsive phenomena, encephalic or spinal, are quite identical with hysteria in women. Kirmisson (*System du Chirurgie*, par Duplay and Reclus, Vol. 4, p. 300) gives American surgeons the credit of being the first who called attention to the analogy which subsists in the consecutive neuroses witnessed after spinal injury and hysteria in women. Rigler (Brelin Klin. Woch. p. 127) has sagely remarked on the much greater frequency of the hysterical phenomena after spinal injury in railway accidents since the laws have augmented the responsibilities of companies. In reviewing Ashursts' series of 394 cases of spinal injuries, I can find no cases of concussion cited in which there are not clear and incontestable symptoms which pointed to organic lesion of the spine or hysteria. In Dr. Liddell's very exhaustive and interesting article on "Surgery of the Spine" (p. 788 vol. 4, *Int. Nat. Encyclopaedia Surg.*) a case is reported under the head of "Spinal Concussion" in which the immediate death of a military officer in action, it is said, was caused by a "concussive injury of the spine." The author says that the officer was struck by a ball in the left lumbar region with such force as to tear open the abdominal walls and let out the bowels. Gen. Humphrey, who was present and saw him mortally injured, said that when struck he straightened up, rolled his eye-balls and fell dead from his horse. On examination of the spine, *post mortem*, a negative condition was found. How, indeed, in this case by any stretch of the imagination the "spine" could be in any way blamed for a share in the death of the unfortunate soldier is quite incomprehensible to me. Here we can imagine the tremendous impetus with which the missile struck to open the densest part in the abdominal wall and leave a breach of sufficient capacity to permit intestinal extension. A cannon shot, cannister ball or fragment of shell that disemboweled this officer had it struck in any other part of the abdominal parietes was quite enough to instantly destroy life. A violent blow with the clenched fist over the trachea has been known often to instantly kill. A kick over the testes produces very dangerous shock.

It is a significant fact that among the great number of railroad employees annually injured on American railroads there are almost none reported as suffering from "spinal concussion." It is only since this injury has become fashionable, has become vulgarized, as a part of every railway collision we hear so much about it. No one ever found a pus tube in all the centuries of our science until Tait stumbled on them, as it were, and recognized their true character. Now, pelvic abscess of every description, with the average operator, is a pyo-salpinx or nothing. But the complexity of names for the same conditions in the surgery of pelvic suppurations in no manner influences or touches the principles of treatment.

On the contrary, in injuries to the back the importance of an exact nomenclature is of cardinal importance in aiding us to appreciate the precise nature of the pathological conditions, which do and do not exist as a consequence of accident. To the average patient and to the mind of the lay public, a sprain, a bruise of the back or rupture of a sinew (?) are simple matters. But when it is announced that one has an "injury of the spine"

has "concussion of the spine," etc., these terms carry a terrible significance.

In the foregoing observations I have been enabled to study rachidian lesions and those involving the spinal cord in the human subject by availing myself of what Dr. Bowles designates "accidental experimentation on man," or rather by a methodical and critical analysis of the clinical manifestations of spinal injuries as they came under my care in hospitals and elsewhere, and in writing for contemporaneous journals a few isolated cases bearing on this study have been reported by me. In fact this is the only method by which it is possible to arrive at safe and reliable deductions, for, as stated at the outset, although much may be learned through experimentation on animals of the grosser spinal lesions, those of a complex pathology and those which extend into the mental domain of man are in no manner completely elucidated by such a resort, however extended or intelligently pursued.

Although few can unqualifiedly accept the dictum of Erichsen on the pathology of spinal lesions of a traumatic character, all must concede that he has been to their study and elucidation what Lister was to anti-septic surgery. His studies revolutionized the pathology of spinal traumatism and imparted that initial impulse which has lead to earnest, profound and analytical study by the scientific investigation of pathological process in a region which before his time was a veritable *terra incognita*. He imparted that initial impulse which has lead to earnest, profound and analytical study by the scientific investigation of pathological processes in a region which before his time was a veritable *terra incognita*.

Let us hope then, that with the rapid strides so characteristic of modern scientific progress this "century of all centuries," with the large number of trained and cultivated investigators in the field; with the wealth of valuable knowledge bequeathed to humanity by our fathers in medicine, with the facilities which modern genius have placed in our hands, and actuated only by an incentive of reaching the truth, nature will soon yield up those secrets wrung from her by those *savants* who have illuminated the way for their followers, and that in the near future the pathology of traumatic lesions of the spine may rest on a secure foundation, by which they may be recognized, relieved or cured; and that the obscurities which now enshroud them may soon fade into the oblivion of the past.

CLINICAL REPORT OF SEVENTY-ONE CASES OF SPINAL INJURY—CLINICAL
EXPERIMENTAL INVESTIGATIONS ON THE HUMAN SPINE—TRAU-
MATISMS OF THE BACK, STIMULATING ORGANIC DISEASES OF THE
SPINE.

First Case—In the month of June, 1884, a case was entered at the Ninety-Nine Street hospital with the following history:

Patient 21 years old, single, female, domestic. General health poor. Stated that three weeks previously she slipped on an orange peel or something of the sort on the sidewalk and fell with great force on her back and left hip. With a little assistance was able to get home. The following day complained of great pain in the back and extremities. Had a medical attendant, but not improving and being informed that her spine was injured, she came to the hospital.

Condition on Admission—Patient rather anaemic; pulse 110; temperature, 102.1-3; considerable thirst; no appetite. She declares that her legs are paralysed. No incontinence. Patient has distinct cardiac murmurs. Gives a history of rheumatism.

Diagnosis—Recurrent attack of muscular rheumatism, and was so treated by colchium, quinia and the alkalies. She was up in four days and discharged cured in a week.

Comments—There were no logical grounds in the case to connect her fall with her rheumatic attack. The absence of sphincteric incontinence, the presence of hyperæmia and a cardiac lesion were the main objective symptoms which we relied on in diagnosis.

Second Case—This patient's case should scarcely come under this heading, for she had real organic disease of the cord; but as it followed soon after an injury and in many particulars simulated a traumatism, it seemed to me opportune to enter it in this place.

History—As this patient's antecetant and personal history have been previously given in full detail by me in the journal of American Medical Association and the *Railway Age* for September, 1892, there will be presented here but a few of its most remarkable features. Patient admitted into medical service of Dr. John B Reid, Harlem hospital, June, 1891. At this time she had complete paraplegia, though the sphincters were intact. Not making any improvement in the medical division, she was turned over

to the surgical side. She gave a history of having sustained a very heavy fall during the month previous in the city of Bridgeport, Conn., from whence she came into our service. As in the preceding case she, too, was able to make her way home after injury by walking, but required the aid of two persons to support her, one either side. After a few days' rest in bed she was able to be about again. In the course of a month's time, however, she commenced to notice that her legs were in patches numb, and that it was impossible for her to walk much without support. This condition became much worse and in time full paralysis developed. (This was not a litigation case.)

Diagnosis—Potts' disease, hastened by a traumatism. On close questioning her I was quite assured that she was suffering from tubercular rachitis. Her father and mother were both tubercular. She gave a history of a "weak back" *before* the injury, which required her to rest her head on the shoulders, the elbows supporting the weight, and when she walked she said she felt slightly unsteady in her gait. After being in my service three months she developed a well-marked angular curvature in the mid-dorsal region. She ultimately made a complete recovery, though not until ankylosis had consolidated the diseased segment.

Comments—This was an ideal case for a clever lawyer to work upon, with every prospect of success, had the question of litigation risen and she had deliberately suppressed the truth.

Third Case—This patient I saw in consultation with the late Dr. George E. Hubbard of New York in the winter of 1885. She had been injured a few days before I saw her while attempting to mount a new car on one of our elevated railway lines. The car being new, the springs on the trucks raised it up a few inches higher than the usual distance. She was large, old and very fat. She stumbled in getting on, one of her lower limbs going down between the car and platform, when she was dragged four or five yards before the train was stopped. When she was lifted out, she was in great shock. An ambulance was called and she was taken home. When I saw her, the injured limb was greatly swollen, but she steadily maintained that her spine was injured, as she was entirely powerless in her lower extremities, and the back was the seat of great pain. There was no question but there had been great commotion of the body by the violent squeezing sustained, but I could not find any unequivocal signs of spinal injury, and hence informed her that her spine was not injured; that she had no paralysis and would soon recover from the pain in the back. As she was not getting proper care at home, she entered my service at Ninety-ninth Street hospital. She remained there for nearly three months. There by a close observation of the clinical symptoms it was apparent after about two weeks that she was a victim of chronic rheumatism.

Diagnosis—General contusion of the body, with consecutive arthritic inflammation. She finally recovered her usual health. On trial the railroad company denied neglect and by the aid of abundant testimony and their own physician proved that she was partly infirm at the time of injury from a rheumatic affection.

Comments—This case properly belongs to the same category as the preceding two. But this patient while in bed, unconscious to herself, would in certain positions induce genuine lateral or angular curvature in the dorsal region. When she sat up it all disappeared.

Fourth Case—Patient a woman, whose case has been previously reported in the *Railway Age*, Aug. 12, '92. A short summary of it may be given here. I was called to see this case in consultation with Dr. J. M. Bryan of this city. Patient some four months before had fallen through a rack on which she had been standing while hanging clothes on a roof. Only one leg went down, but it appears that her body was pretty well contused by the accident. Patient was sent home and was attended by a physician sent by the owner of the house on which the accident happened. After six or eight weeks' treatment he, regarding her well, dismissed her. But she took it into her head that she had spinal disease, paralysis, etc. The medical gentleman who was called in at this stage found the woman helpless, in bed part of the time, with little or no use of her limbs, suspected paralysis. This opinion was further heightened by the fact that there was no ankle clonus and the patella reflexes were entirely absent. And so a needle might be sent into the eye in any part of her lower limbs without causing a twinge of apparent pain. By resorting to a ruse and inquiring about her it was soon evident that she was an impostor.

Diagnosis—From what could be learned she had primarily a sprain of the neck and hip with two or three patches of ecchymoses on the buttock of the same side. That was all.

Comments—In this case, in which patient had claimed invalidism so long, one would naturally expect marked trophic changes, particularly in the vessels and muscles. But there was no trace of them. The skin had a warm, moist healthy glow and there was no evidence of any atrophic or degenerative disturbances in the muscles. But like the latter case cited in bed she could produce the most remarkable deviation in the cervico dorsal segment, a genuine lordosis.

Fifth Case—This patient was a boy who came under my notice in the Harlem hospital during the past winter. He came in for treatment of a necrosed tibia. But one of the staff discovered what he supposed was "Potts disease of the spine."

History—Patient came of healthy father and mother, both living. First symptoms of trouble in the leg began a year ago, when he fell down a flight of stairs. Never complained of his spine. He now had, while in the sitting posture, a marked cyphosis in the upper dorsal segment of the spine. But there was no paralysis, no muscular wasting or anything suggestive of serious nutritive changes in the soft-parts.

Diagnosis—His spinal condition was evidently due to muscular and ligamentous relaxation, possibly from injury to the dorsal or posterior branches of the intercostal nerves which supply the greater part of the spinal muscles at this point. But there was no organic lesion.

Comments—It should not be forgotten that asymmetry in its strict sense is practically a normal condition in the growing spines of children, *i. e.*, one side grows more rapidly than the other, or its development is more advanced than the other. Hence we should expect to find the "lopsided" very common, particularly in strumous children. The situations in which this simulation of spinal deformity was most pronounced in the above case were, in one, first in the dorsal and then in the dorso-lumbar. These cases have been classed as "simulated" because there were in none the indications of cord injury. There was a visible tangible distortion in all, which, nevertheless, entirely disappeared on taking the erect

position. In the considerable group to follow of the pseudo-concussive variety, we might with every propriety include them in this class, only they were not attended with spinal deformity.

TRAUMATISMS IN THE CERVICAL REGION.

Sixth Case—History. Patient's age, 40; fresco painter; admitted into Ninety-ninth street hospital May 2, 1883. Patient while embellishing the dome in the chancel of the church, the staging gave way and he came downward about 30 feet, striking on his neck and shoulders across the back of a pew. He was taken up in an unconscious condition in a state of extreme shock. By the aid of rest and restoratives he soon rallied so that on the arrival of conveyance the ambulance surgeon considered it safe to remove him to the hospital. I saw him an hour after he was admitted to the hospital. His faculties were now clear and he expressed an earnest desire to get well. But he was suffering the most agonizing pain on the slightest motion. At this time he was powerless to move either hand or foot. Sensation was wholly lost in the lower extremities, though on puncture with a pin he was conscious of some feeling in the hands and forearms. Between the sixth and seventh cervical vertebrae there was a distinctly moveable bony substance, no doubt the spinous process of the sixth, which had become detached. His urine, on withdrawal by the catheter, was found bloody. There was unequivocal evidence of injury to the internal organs. Besides the spinal injuries he also had fracture of the left scapula and dislocation of the right shoulder.

Diagnosis—Mortal injury of the spinal architecture, with fracture, hemorrhage and compression. He died ten hours after injury, before reaction. *Post mortem* examination was refused us. But an autopsy was made by the coroner's deputy after his removal home. Dr. Harold, who made the examination, informed me that fracture and compression of the spinous processes of the sixth and seventh cervical vertebrae were discovered, besides extra and intra-theal hemorrhages in the spinal canal, hemorrhage into pleural cavity, rupture of the right kidney, with a free retro-peritoneal extravasation.

Seventh Case—Patient large, heavy man, aged 44. Injured June 22, 1883. While out driving in Central Park, in a light buggy, saw a runaway horse coming at a furious rate in an opposite direction. Before he could swing his own vehicle aside to clear the way the horse and carriage collided, upsetting his buggy and throwing him some distance on the hard road bed. He was stunned for the moment, but by the time the police arrived he had recovered his senses, though on making an effort he was unable to rise. He was brought in by an ambulance to the Ninety-ninth street hospital, reaching there at 5 p. m. At 8 I saw him the same evening. He now complained of much pain in the right side, and was unable to raise the hand on the affected side. On the side close to the sternal attachments he had fractured the fifth, sixth and seventh ribs. He had more power in the left hand. He could move both feet. The neck had been violently strained, and under the left ear there was a large patch of ecchymosis. The head and neck were rigidly fixed, and the slightest pres-

sure, over the median spinous process elicited the most excruciating pain. He had considerable thirst, but could only swallow in gulps and at intervals. Pulse quick, 124; no temperature; can void his urine.

Diagnosis—Mixed case of *centric* and *excentric* injury of the spine, with the latter predominating, costal fractures and contusions.

June 23d. His general condition much improved. Pulse 100; temperature 100 1-2; can swallow better, but numbness and weakness in the arms continues. Says to-day that he has pain in the back of his head. Has some slight deafness in one ear and ringing in the other.

June 24th. Sitting up, rapidly improving; pulse 101; temperature 100 2-3; numbness leaving the arms and bodily strength returning. The vomiting which he had soon after entry has ceased and he now takes food freely.

June 27th. Left the hospital to-day. Spinal symptoms have nearly all disappeared.

July 21st. I saw him on this date for the last time. He had now fully recovered and was attending to his usual occupation as a cutter of brown stone.

Comments—This case calls for a few comments. It was one of that common class of severe injuries of the body consequent on collision or concussive violence, in which the spine escapes serious harm through the force being first met and spent on the soft parts and the structures adjacent to it. It practically belongs to those cases designated by Bergman, Phelps and others as *contusion* of the spinal cord. The cord was unquestionably slightly involved. Sudden tension, torsion and pressure gave rise, probably, to a very slight meningeal or parenchymatous bleeding into the cord, but not of sufficient extent to excite inflammation or dangerous compression. The symptoms also indicated a propagation of the lesion into the base of the brain.

Eighth Case—Patient admitted to Ninety-ninth street hospital Oct. 5th, 1885. He was a man of large stature, muscular and well developed. Age, 28 years. On the afternoon of above date, while climbing a ladder with a pail of water in each hand a round broke and he was precipitated downward a distance of 15 feet. He fell backwards, striking on his back. He was picked up in an unconscious condition and brought into the hospital twenty minutes later (the accident occurred near the hospital). He was now in deep shock. About four hours after injury seen by me. At this time his pupils were contracted. He breathed in deep, irregular gasps. The pulse was slow, full and slightly irregular. The extremities were motionless. He was unconscious and in a wild state of delirium.

Oct. 6th. No symptoms pathognomonic of fracture of base of the skull; lower extremities partly paraplegic; still more or less muttering delirium; pulse 103; temperature 99 1-2.

Oct. 7th. Mind clear, no fever; can now move left leg and has slight sensation in the right, but is unable to move it; pulse 90; temperature normal; complains of deafness so that we had to speak to him in loud tones to be heard.

Oct. 8th. Temperature and pulse normal. Neck rigid; the spinous process of the fifth vertebrae prominent; seems unduly mobile and deflected slightly to the right side; vomiting ceased.

Oct. 26th. Left the hospital. Pain in the head ceased and hearing improved; muscles of the neck yet quite rigid and hyperaesthetic; can only

walk with the aid of crutches and the digital grip remains feeble. It was more than a year before this man fully recovered. But he finally wholly regained his health, and is now a patrolman on the Metropolitan police force of this city.

Ninth Case—This case was in my service, in the Workhouse hospital, on Blackwell's Island, New York.

History—Patient a prisoner, middle sized, aged 27. On the morning of May 21st, 1884, while descending from his cell on a high tier, fell the whole length of the steps, striking on the landing below with great force. When raised from the stone floor on which he struck he was wholly unconscious and blood flowed freely from his mouth and nose. As soon as he was placed in bed he was seized with convulsive spasms, which, however, the house surgeon informed me, did not extend into the lower limbs. He came under my observation the following day, May 22d. At this time he has regained consciousness and complained of no pain, except in the cervical region of the spine. Here there was well-marked ecchymosis, tumefaction and induration of the tissues. The head was fixed and the cervical muscles tense. Drinking was attended with much pain. As he could not raise his head, all liquids were given him through a tube.

May 24th. Paraplegic symptoms evident, though the sphincters were intact. General condition much improved. On this day I made a discovery which shed much light on the etiology of his condition prior to the accident. It was noticed as he thrust his tongue out that its lateral borders on both sides were freely indented with scars. He was a chronic epileptic. After remaining in the hospital three weeks his condition was greatly improved, but he refused to use his limbs. As malingering was very common in this service a ruse was resorted to to see whether or not he was shamming. Therefore we said to him that, as his paralysis was making no progress toward recovery, it would be necessary the next time I came to use the actual cautery and "fire" each side of the spine without an anaesthetic, as this would impair its full effect. On my next visit, in three days, he had quite recovered the use of the paralyzed legs, and walked about the ward without a support of any kind. His time of committance was out in another week, when he left the hospital apparently as well as ever.

Comments—his case presented many features of unusual interest and points to a vital question in etiology and clinical history, viz.: The important role which pre-existing pathological conditions play, both as predisposing and aggravating factors, in bodily injuries of every description and those relating to the spine in particular. Here we had a most startling array of symptoms. Free hemorrhage into the mouth and nose, in connection with a spinal injury, would lead one to assume that it had made its way through the pharynx from a rupture of the anterior ligaments of the spine. The coma and convulsions implied serious brain injury.

Diagnosis—Epileptic seizures primarily, spinal injury consecutive. Except the physical evidence of injury of tissues of the neck over the cervical spine, it was indefinite what the nature of the other complications were. Being a prisoner and under the severe discipline of a reformatory institution, we were permitted opportunities to unmask the case quite unknown with a private case.

Tenth Case—History—Patient 50 years old, a hard drinker, admitted to the Harlem hospital Feb. 12th, 1887. Was found by the police on the morning of this date in comatose condition, presumably from the effects of alcohol, but they, not being able to arouse him, called an ambulance and sent him to the hospital. During the evening, about two hours after he was found, he regained consciousness, when he complained bitterly of his occiput and cervical spine. His neck was now fixed and exquisitely sensitive. Deafness, which he said was recent, was well marked, but there were no symptoms of basic fracture of the skull. There were two abrasions on the back of his neck and a fracture of the transverse and spinous process of the sixth cervical vertebra could easily be defined. Both extremities were completely paralyzed, and but slight motion remained in one arm. Tachycardia, quick, irregular breathing, and almost incessant vomiting were constant and persistent symptoms.

Diagnosis—Fracture of the spine, extra dural hemorrhage, laceration of the cord, consecutive meningeal and myelitic inflammation.

Feb. 12th. Temperature 102, pulse 122; relieved from pain by full hypodermic dosage of morphine; incontinence of urine and faeces; the act of deglutition gives great distress; the features were intensely suffused, of a deep crimson hue; had some relief by being turned on his side.

Feb. 13th. The same symptoms of the day preceding, except more accentuated.

Feb. 14th. Vomiting ceased, but now a painful cough has commenced. The abdomen is ballooned and he begins to complain of epigastric constriction, the so-called "girdle symptom." Condition continued daily worse until the morning of the 17th. Now it was evident that pathological processes had reached the roots of thoracic respiratory reflexes and had even crossed the foramen magnum, engaging in the basic meninges. Respiration was purely diaphragmatic, quick and labored. The mucus which was exuded from the respiratory mucous membrane became extremely tenacious and was slowly but steadily blocking up the air passages and causing asphyxia, as now all power of its expulsion was past. Spasm intermittently spread into the muscles of his face, and by a cloic tension of the internal recti of the eyeballs the eyes were now in a state of convergent strabismus. He was now in a condition of delirium. Early on the morning of the 18th he died.

Post mortem Examination—We were restricted by his relatives from proceeding further than opening the spinal canal. The spinal cord was opened from the occiput to the sacrum. The spinous process of the sixth cervical vertebra was discovered fractured on both sides, close to the transverse processes. One fragment was partly turned on itself in such a manner as to press directly on the dura-mater spinalis. The spinal canal, outside the cord, from end to end, was found stuffed with liquid blood and partly organized blood clot. Now, by bisecting the theca through its entire length, it was seen that directly under the point of fracture there was a free intra-meningeal hemorrhage from a laceration of the posterior spinal artery. From the site of injury upwards the dura mater, arachnoid and pia mater were all glued together by a free fibro-plastic exudate of lymph. The substance of the cord was in places so softened as to render its removal entire quite impossible. This was most marked at the point traumatized. This man, as later ascertained, had been injured by being run over by a cab through the carelessness of the driver.

Eleventh Case—History—Patient, a boy of 14 years, was admitted to Harlem hospital in January, 1890. On the morning of this date he was seized by a muscular, irate mother and thrown bodily out of the fourth story window of a tenement house on to the stone-flagged sidewalk below, after which she made a plunge, in a moment of remorse, landing a few feet from where he struck. They were both brought in in the ambulance together. The boy was suffering from shock but was entirely conscious. Could move his hands freely but could not do so with his feet, which, he said, felt numb. There was a large patch of ecchymosis on one side of the nates and another contusion and abrasion over the lumbar region. He had control over the bladder and rectum.

Diagnosis—Probable violent contusion of all the rachidian muscles, concussive force extending into the spinal marrow and thereby inducing temporary abeyance of function. By evening of the same day was able to get out of bed and use his legs as well as ever. He now clamored loudly for his supper. A few hours later, in the absence of the orderly from the ward, he slipped on his clothes and absconded as chipperly as a cricket. This boy made a "bee line" for home, and, as far as could be learned subsequently, he never has been any the worse for this rather heroic sort of maternal discipline. It was most remarkable, in a fall of such great height, that there were no bones broken or internal organs damaged.

Twelfth Case—Patient, a female, admitted on the same day as the preceding case and injured in a similar manner (mother). She was 37 years old, of good physique, weighing about 150 pounds. When she was found by the ambulance surgeon she was in a semi-conscious state. She had a scalp wound over the left ear, which was bleeding freely. This was temporarily dressed when she was brought to the hospital. By the time she was undressed, sponged and placed in bed, she had quite recovered consciousness. On a more careful examination of her body no fractures or dislocations were discovered. But she declared that her "neck was broken," as she said that every time she moved she felt a "crick." In confirmation of this, too, it was noticed that, while she could move one leg freely, her arms were both quite powerless. But sensation was little, if at all, affected. Hence it was a question whether this helplessness was attributable to a severe contusion of the muscles or injury to the cord. She had an extensive laceration of the left leg, from the inner side of the knee down as far as the ankle joint.

Diagnosis—General contusion of the body, with extrensic injuries to the cervical spine, and contusion of the cervical segment of the spinal cord. On the fifth day after injury movement of the hand began, and the numbness which she complained of had quite disappeared. On the tenth day she left the bed, returning home, restored to her former health. I have seen her several times since, and, as far as I know, she has been as well as she ever was before she made the leap and escaped with her life. These two latter cases go a long way to prove what is a matter of common observation among surgeons and experienced observing mechanics and builders, viz.: That the extent of injury is by no means always in direct ratio to the distance one has fallen, but that it more often depends on the manner in which one lights as the body comes in contact with the surface.

Thirteenth Case—History—P. O. B., age 24, male. Admitted to Harlem hospital July 12th, 1887. Patient, while in the act of diving in the water at a pier on the East river, struck his head with violence against the shallow bottom. The tide was out at the time, his head and neck being pro-

jected with great force against the hard river bottom. His comrades, observing that he did not rise to the surface, plunged in and rescued him. At first they supposed he was dead, but by diligent and intelligent manipulation, rolling him on the beach, etc., he soon gave evidence of reviving. He was freely rubbed with warm alcohol, and subcutaneous injections of ether were administered. He was now wrapped in blankets, put on a stretcher and placed in the ambulance. Was in great shock and entirely unconscious for the first twenty-four hours in the hospital. Indeed, collapse was so deep it was not deemed advisable to examine him until some more hopeful signs were evident.

June 13th. Has recovered consciousness, but is paraplegic and palsied as far up as the nipple line. There was intense suffusion of the facial capillaries, with a deep, dusky hue of the features. Pulse 130, temperature 99 1-4; abdomen distended, the sphincters paralyzed, moderate vomiting; complains of great pain in the neck; marked dysphagia, diaphragmatic breathing; on most diligent examination no evidence of fracture was discovered, though the whole cervical segment was extremely hyperaesthetic over its spinous processes.

Diagnosis—Extra thecal hemorrhage into the spinal canal, consecutive compression of the cord. Violent contusion and laceration of the muscles of the neck. Paraplegia, consecutive to and dependent on hemorrhagic pressure.

June 14th. This morning had a rigor and shook all over. One hour later, temperature 102, pulse 131; paralysis of the lower extremities now complete; complains of constriction over the epigastrium; lies on his back, fairly comfortable when under moderate dosage of morphine; continued in about the same condition, without the development of any special change except the development of a bed-sore.

June 19th. Temperature this morning suddenly mounted up to 105 1-4; pulse 134. Wandering delirium commenced. Paralysis of upper extremities. Meningeal inflammation rapidly advancing upward; unable to swallow anything. He struggled on, breathing in quick, short gasps, the cyanotic state of the integument deepening in proportion as the respiratory reflexes became involved.

July 20th. At 2 a. m. he died. A *post mortem* was refused.

This case is of interest as one in which there is every reason to assume there had been a mortal termination from spinal hemorrhage as the primary lesion. In my experiments on the lower animals it was found that in all cases of extensive spinal hemorrhage a fracture of the vertebral column somewhere could invariably be found. It is true there may have been one here, but if so there was no displacement. But, as will be seen later on, a fracture in the spinal column of man is not a necessary factor in all cases of spinal hemorrhage of a traumatic origin. It was interesting to note here, too, that it was only on the third day after a violent chill, that the temperature went up. Here was the starting point of a new process which, when it develops in the course of spinal hemorrhage, adds enormously to the gravity. In only one case in which meningeal inflammation has been engrafted on spinal hemorrhage have I seen the patient survive.

Fourteenth Case—History—Patient 29 years old, admitted to hospital June 12th, 1888. On the morning of the above date, at an early hour, this man attempted suicide by cutting his throat. But he committed the mis-

take common with this class and carried the blade of the razor too high, cutting off the epiglottis, dividing several muscles, vessels, etc., and, passing through the pharynx, made three or four deep gashes through the bodies of the fourth and fifth cervical vertebrae. As none of the main blood trunks were divided, he failed to destroy himself. A neighboring practitioner was now called in, who secured the bleeding points and applied a temporary dressing. He was then sent to the hospital. After he had rested in bed about four hours, he commenced to manifest signs of distress. He was now taken into the operating room of the hospital to be examined and have the dressings readjusted. This was on the second floor of the hospital in the front of the building. The house surgeon had been called for a moment out of the room, while the nurse was in an adjoining room in which surgical dressings are stored. During this brief interval that he was left unguarded he raised himself from the operating table, made a bound for the window and dove headlong into the area below, a distance of about twenty feet. When raised from the ground he was in a moribund state; blood issued from his mouth. The pulse was fluttering and irregular and he breathed in irregular gasps. His right ear had nearly been torn in two; in a vertical direction. It was evident that he had fractured or dislocated the atlas or third cervical vertebra, for there was a distinct crepitation and abnormal mobility. As he was in the dying state, it was impossible to determine the extent of damage to the brain.

Diagnosis—Fracture or dislocation of the cervical segment of the spine, with compression of the substance of the spinal cord and mortal shock with probable internal injury.

The unfortunate man survived but a few moments after re-entering the hospital.

Post mortem Examination—Autopsy made by the deputy coroner. Cranial, spinal and abdominal cavities opened. The second cervical vertebra was fractured through both its laminae. The posterior atlo-axial ligament was torn in two and there was a distant displacement backward of the body of the third cervical. Duramater on its left lateral aspect torn for a distance of nearly an inch, to and through the second and third cervical nerve roots, anterior. Substance indented and lacerated at point of fracture. On opening the skull there was discovered a linear fracture, about two inches long, extending in a horizontal direction about an inch below the tip of the ear. The middle meningeal artery was lacerated and had given issue to an abundant hemorrhage, which had formed a large clot and produced a distinct compression of brain substance. None of the other cavities were examined. I must here acknowledge my obligations to Dr. Jenkins for his courtesy in permitting me to assist him and make notes on this case. As *post mortem* labors are very unpleasant and repugnant to most physicians and as they are often necessarily done by internes, who examine only those organs which give rise to the most prominent symptoms, most valuable information is often lost and pathological revelations of great interest and value are never made known. Though in this case there was considerable direct damage to brain and cord by this madman's plunge, to my mind it would seem that there was not enough to immediately destroy life without coincident trauma of the solar plexus, the circulatory apparatus or internal organs, but none such were discovered. There was but little hemorrhage into the spinal canal because of the in-

direct character of the circulation in this region and the violent shock which induced immediate vaso-motor paralysis.

Fifteenth Case—History.—O. C., aged 29 years, admitted into the Harlem hospital July 13, 1889. On the afternoon of this date, patient went to bathe at Port Morris. Without first taking the precaution to sound the depth of the water, which he was about to enter for the first time, he ran a few yards and dove in, head first, from a dock which was about eight feet above the water's surface. After sinking, he rose once and went down again to remain. One of his comrades, an expert swimmer, who was well acquainted with the river bed, fearing that something serious had occurred, dashed in after a moment's delay to see if his friend, who was a clever swimmer, was not playing a ruse. He found him and quickly dragged him to the landing. He had ceased to breathe, but the heart was yet beating. His comrades worked on him, employing artificial respiration, and after a few moments he commenced to respire again. He was now in an unconscious state. An ambulance was telephoned for and an hour later he was entered into one of the surgical wards of the Harlem hospital. He was now carefully examined, but no fracture of the spine or skull could be detected. His respirations were deep and stertorous. Pulse 56, temperature subnormal. No fracture or dislocation of the limbs could be discovered. His bladder, which was distended, was emptied by a catheter, and hot alcohol sponging was kept up until reaction had set in. He remained unconscious until the following morning. Now reason had completely returned and for the first time he was conscious to pain. He complained of a most excruciating pain in the neck about the vertebrae. The position which gave him most comfort was with the occiput powerfully retracted backward and rigidly fixed. Lateral pillow supports gave him great comfort. On this date, temperature and pulse normal. Now he was completely paraplegic and the palsy extended far upward, rendering one arm powerless, the left and the right devoid of sensation, though some slight motion remained.

Diagnosis—Extensive lacero contusions of the muscles of the neck, hemorrhage into the spinal canal with compression of the meninges and medullary substance.

July 15th. Very serious and sudden change in his condition; 9 a. m. temperature 104; pulse 126; incessant vomiting; rapid, gasping respiration. Actively delirious and incessant screaming. Face and neck deeply congested. Both arms now completely paralysed. Hypodermic injection of morphine quieted him somewhat. But as evening approached he became rapidly weaker and died at 9 o'clock.

Post mortem examination of the body was refused; but we were permitted to open the cervical spine. On incision through the thick, dense skin over the neck potently an inky-colored fluid blood issued up through the opening from various directions. All the cervical muscles were deeply blood-stained. On opening the spinal canal liquid blood flooded the track of the saw and required constant sponging. On removing the posterior arches of the vertebrae it was seen that the spinal canal was so completely clogged with blood that it had in places made its escape through the intervertebral notches from the nerve roots, outside their thecal envelopes into the sub-jacent tissues. After all the sanguinous effusion had been washed away, the fibrous envelope of the cord came into view. It was nowhere lacerated. On bisecting the dura a turbid, flocculent fluid escaped from the arch-

noid cavity. The visceral layer of the arachnoid was markedly thickened and intensely congested. Beneath this all the spinal veins were found greatly engorged. The membranes were not adherent, though layers of plastic lymph were scattered over the pia mater and on its inferior surface on the marrow. There was no hemorrhage into the medullary substance of the cord, though throughout it was stained of a deep pink tinge in the mid-cervical region. The so-called "red softening" was present, but as this man died early disintegrating changes had not yet set in.

Comments—This was a typical case of spinal hemorrhage, with all those phenomena which attend it when it is free and copious. Its compressive force is enormous when in large quantities; else the spinal cord, which is nowhere in contact with it, but well protected by a water bed in which it floats, would always escape destructive pressure. And it is a question in this class of patients whether or not the cord might not escape and the injury be survived, if it were not for that fatal type of meningitis which the mechanical pressure of hemorrhage gives rise to in this situation. As the vertebrae were not removed it was impossible to say whether or not the bodies had been fractured.

Sixteenth Case—History—Patient a male, 40 years old, painter. This patient came under my care April 12th, '89. He was employed painting the elevated railroad structure. By the slipping of a knot the ladder on which he stood gave way and he fell to the street below, a distance of about twenty feet. Though not rendered unconscious, he was badly shaken and unable to rise. An ambulance was called, but he refused to go to the hospital. He was taken home. I saw him about six hours after injury. He was now very pale, had bleed some from the nose and had vomited once, raising some blood with the ejected fluid. Complained of pain in the abdomen; was slightly deaf his wife said. Has numbness in one foot and in both hands, but can use them; says his neck is badly hurt, as he only moves it with great pain. There are no bones fractured. There are several abrasions on the face and hands. On stripping the body a hernia on the right side was discovered. But it was not sensitive and was easily reducible. Says he has not seen it down before for some time. On the second day after injury numbness left the feet, but there yet lingers a weakness in his hands, with diminution of sensation. On the sixth day hands had fully recovered their strength; is up and feels quite restored, except for the tumefaction in the neck and great pain on rotation or flexion.

Diagnosis—Severe sprain of the neck and body with contusion of the cord and probably some hemorrhage into the canal. Slight motor and sensory paralysis. Patient steadily improved, and after one week was able to be out. In this case in which the head and spine had sustained severe concussive violence in consequence of the body being projected against it, and the weight of the ladder coming on the body as it fell also, though there was an extreme bruising of the whole body and some slight injury to the cord, there had at no time been any elevation of temperature. He made a perfect recovery.

Seventeenth Case—History—Patient a robust young sailor, 24 years old, admitted to Harlem hospital May 2, 1889. On the evening of the day previous this young man, then serving on a coast transport which lay off the Connecticut coast in a rough sea, climbed a ladder on the bow of the boat to place the signal light in position. As he reached mast top and was about to descend the boat gave a lurch, his hands lost their grip on

the moist ropes and he came headlong to the deck below, a distance of about twenty feet. When he attempted to rise he was unable to do so. An hour later he was found in his helpless condition by the night lookout. He was now raised and carried below. In the morning the boat put into the Harlem river and was made fast to her dock. This was about 11 o'clock. At this time an ambulance was sent for and he was brought to the Harlem hospital. I saw him in the afternoon of the same day. At this time he was suffering from excruciating torture in the back of his neck. Owing to the great contraction of the dorso cervical muscles the head was so far drawn back as to give an unnatural prominence to the anterior aspect of the larynx and trachea and cause a strong suspicion of vertebral dislocation. By examination of the pharynx through the mouth this was negatived. So marked was this distortion that the house surgeon, when he was first admitted, supposing it to be a case of dislocation undertook to reduce it. But on careful examination a distinct fracture of the sixth cervical vertebra could be easily made out. At this time there was no paralysis, though he bitterly complained of pain in the fractured part. Morphine had to be given him, and the head with the neck firmly braced gave him some comfort and ease. On the following day paralysis commenced in the lower extremities. Temperature 102; pulse 116; breathing hurried and painful. Refused operation on the spine. On the next, the third day in hospital, securing no sleep in great distress through the pain in the head he begged us to relieve him by an operation if necessary. At this time paralysis had advanced as far up as the lower segment of the brachial plexus. The full details of the case were published in the *New York Medical Record* for October, 1890. They will not be repeated here. Suffice it to say that the entire posterior arch of the sixth cervical vertebra was found fractured off on either side close to the transverse processes. There was no depression of the fragments on the cord. The operation was terribly bloody. As these fractured lateral plates were detached from their ligamentous connections and the blood was sponged away, the pearly white surface of the dura mater came into view. The theca was not opened. Now the head and neck were fixed in a cuirass of gypsum after the wound had been properly dressed. This osteectomy made no improvement in his condition. The fixed plaster dressing he could not endure. It had to be removed. But now a new difficulty arose. In consequence of the loss of the bone plagues the head toppled about without the support which these bones gave. To make matters worse six hours after operation a secondary hemorrhage set in from the deep rachidial meningeal vessels within the canal. Firm pressure could not be brought to bear on them without crushing the cord, so that we had to be content with moderate packing with gauze. But the blood came through this as a sieve. On the fifth day after admission patient was greatly exsanguinated. The operation made no impression on the paralysis; nor in the slightest degree affected the pain for which it was necessary to force the morphine in heavy oft-repeated doses. On the seventh day temperature 106; pulse 140.

Died at 7 o'clock on the eve of this day.

Diagnosis—Fracture of the sixth cervical vertebra. Intra spinal hemorrhage. Consecutive mechanical meningitis. Extensive lacerations of the muscles, vessels and tendons in the neck.

The pain in the neck was one of the most remarkable clinical features

in this case. It may be added here that on the fourth day a large bed-sore formed over the nates, though, of course, he was entirely unconscious of any inconvenience from it.

Post mortem Examination—Thirty hours after death the spinal cord was opened. On enlarging the incision on either end of the original injury everything was found blood-soaked and deeply stained by a sanguinous effusion, which spread widely in every direction. On reaching the spinal canal it was found that its lumen from the point of fracture for more than three inches in each direction was filled with semi-fluid blood between the theca and the cellular walls of the vertebrae. There was no hemorrhage within the dura, but all the meninges were deeply engorged, and in places they had adhered to each other by a fibro-plastic product of a recent inflammation. The white matter of the cord close to the commissures was stained a dark tan color.

Comments—This case of mortal spinal injury was one of unique and remarkable interest. It was the first case of trephining the cervical segment for a traumatism that I can find recorded in the United States. The case illustrated that we may have a complete fracture of both lateral laminae of the vertebrae without injury to the cord through compression by displacement. For in this case, though a multiple fracture was present, there was no compression of the medulla spinalis by inward displacement. Incision and removal of the fragments made no impression on the pathological condition present, but on the contrary rather aggravated it and added two new elements of danger, one of which contributed very materially towards shortening his life. The unmanageable character of the hemorrhage during the operation and the uncontrollable secondary one, after osteotomy, reduced his staying powers to a low ebb. Had he recovered the loss of those removed bones would have so weakened the natural supports of the neck that some sort of a prothetic appliance would have been necessary to, at least in part, provide for the deficiency. In this connection one may inquire why, unless the evidence of medullary pressure is clear and unequivocal, should the fragments be cut out at all, but rather be replaced and permitted to consolidate as broken bone elsewhere?

Eighteenth Case—History—Patient age 36, male, brakeman; admitted to hospital Jan. 27th, 1891. Patient, while on a rapidly moving freight train, suddenly saw, as he stood on the roof of a box car, that he was within a few yards of a bridge which extended over the tracks. He instantaneously stooped the body, but not quick enough nor low enough, as he was crushed from above, the head being forcibly compressed on the chest and he fell on his face, but had the presence of mind to grasp the plank which extended along the car roof and thus saved himself from instant death. He held on in this way until a fellow brakeman discovered his mishap and signalled the engineer to stop the train. He was now lowered into the car. On arrival of the train of the Mott Haven freight yards our ambulance was called and he was brought to the hospital. On admission he was weak and complained of great pain in the neck. There were no signs of fracture or dislocation, but the neck was considerably swollen over the transverse processes. No paralysis.

Jan. 8th. Very sore all over; now has tingling sensations in the feet and unable to move them but slightly. Right arm as far up as the elbow, in places, anaesthetic. Left arm normal. No fever. General condition good.

Diagnosis—Contusion of the cervical spine and all the envelopes outward to the integument. Extra thecal hemorrhage, with limited compression of the cord.

On the fifth day after admission symptoms of paralysis commenced to fade away, and he left for home at the suburbs of the city with no special trouble except bodily weakness and "locked neck."

After six weeks he again returned to the hospital to report that he was again quite restored to health, and proposed returning to work the following day but as a switchman until he felt stronger. Something more than a year ago I have been informed that he was again braking in his usual health.

If this were not a case of typical "concussion of the spine" where can we find one? There were all the cardinal elements so essential, laid down by Erichsen as momentary, mental and physical shock, with great concussive force, yet what do we find? A certain set of symptoms with certain, quite precise and definite clinical phenomena, such as we would expect after such an injury. As those pathologic changes the sequence of trauma disappeared by processes of the economy, health was finally fully restored.

Nineteenth Case—History—A boy, eight years old, entered Harlem hospital June 2d, 1890. Two weeks before he and several other boys dragged a truck up a steep hill when all mounted it and "let it go." The truck went until one of the fore wheels came in contact with a large rock, just at the moment that the truck had attained a high velocity of speed. It now was suddenly thrust one side and turned over, the boys being thrown in different directions, but two were caught and crushed beneath it. These two unfortunate lads had their skulls fractured. All the boys who were hurled down the declivity escaped without severe injury except three. One boy was able to rise and make his way home. He felt sore all over in the evening, but what disturbed him the most was pain in the neck. He was up and about and nothing was thought of his bruises for nearly two weeks, when he commenced to have weakness in his arms and hands with a sense of numbness. At this time he could walk fairly well, but said his feet felt heavy and were at times "asleep." Now his mother brought him to the Harlem hospital dispensary, where Dr. Hoeffheimer called my attention to the case. There was no fever and no pain anywhere except in the back of the neck. The mother said that he could not rest comfortably in bed except on his back with two large pillows under the head and neck. The hands were cold, the grip in both very feeble, though sensation was but slightly in abeyance. Muscles at the shoulder rather atrophied and power to raise the arm mostly lost. Extensor muscles of the neck weak and head maintained in the erect position only by an effort. Under an appropriate therapy the boy made a complete recovery.

Diagnosis—Violent contusion of all the tissues of the neck with compression and tension of the spinal cord. Consecutive subacute meningo-myelitis, trophic wasting in the muscles and a mild phase of paralysis, attributable to disturbance in the nutrition of the cord and nerve roots.

Comments—This case is of interest, as illustrating the pathological changes which are occasionally sustained in the spinal region by children from concussive violence. It is a notorious fact that various injury of the spinal cord in them, except when they are immediately fatal, are very rarely met. Fractures of the skull, of the shafts of bones and dislocations are very

common with the growing child, as they very often incautiously expose themselves to accident and danger. The spinal cord of the child may be said to be practically immune against traumatisms. The only exceptions are those cases in which the child is killed outright, or great force simultaneously crushes in and immediately disorganizes the medullary substance and mortally damages the internal organs. This case was the only one I have ever seen in which the spinal cord has been injured by concussive force in a child.

Twentieth Case—History—J. B., aged 41, locomotive engineer, was injured by a collision on his engine April 12th, 1892. Through a mistake in signals his engine, which was a "shifter," collided with the rear car of a freight train, which was not moving. The engine was moving at the rate of about ten miles an hour at the moment of collision. He was thrown with great force from his seat against the boiler. He was rendered unconscious for a few moments, though by the time aid arrived he had recovered his senses. But the violent commotion which his whole body had sustained rendered him wholly helpless. An ambulance was sent for and he was at once conveyed to the Harlem hospital. On admission he was suffering from shock; pulse weak and thready, temperature subnormal; disposed to vomit; extremities cold. After the application of restoratives he gradually reacted, so that in twenty-four hours his general condition was very fair. Complaints of great pain on the slightest movement of the head. Even the act of coughing or sneezing gives him great distress in the cervical muscles, posteriorly. There is numbness in the soles of the feet, and he is unable to flex the knees; unable to close the right hand; the left is also paralytic, but not so weak as the right; lies on his back, neck-locked; his head can only be raised by elevating the trunk. Temperature on the second day in hospital 99 1-4; pulse 112. His general condition steadily improved after this date. After two weeks all symptoms of his paralysis had disappeared, but the tumefaction in the neck and exquisite sensitiveness lingered even while he was about the ward.

Diagnosis—Cervical traumatism of the spine, with injury to the cord, contusion, probable extensive laceration of the vertebral ligaments; deep-seated effusion, hemorrhage into the muscles of the neck, consecutive adhesive inflammation and muscular ankylosis.

Comments—The main interest in this case lies in the eccentric lesion. Although we had no evidence of fracture here, yet there may have been one or more without displacement. The neck behaved precisely as a fractured limb, the muscular spasms, tumefaction, pain and immobilized state of the parts all pointed to it. When he left the hospital muscular ankylosis or limitation of motion was clearly evident, so that it was quite impossible for him to turn the head without carrying the shoulders with it, as it rested, firmly drawn down, on the shoulders. There can be no doubt but that the fracture of the spine may often occur without anything more than temporary functional disturbance of the spinal cord, and when cure follows more or less ankylosis at the seat of the injury is liable to succeed. This I have abundantly proven in my experimental work.

Twenty-first Case—History—Patient, 26 years old, was seen by me in consultation with Dr. G. D. McGauran June 12th, 1890. The preceding nights having been very hot, and the patient having drank freely of lager beer as the hour for retiring arrived, instead of going to bed he went up to the roof and lay down, as it was cooler there than in the close tenement

quarters in which he lived. Not coming down in the morning for breakfast, a search was instituted, when it was discovered that he had fallen into the back yard, landing on the flagged bottom. In his transit from the roof to the yard below his body had come in contact with and had torn down several clothes lines, which had been stretched across from the windows in each story to a clothes pole in the yard. This network of ropes saved him from instant death. The distance he fell was about 65 feet. He was found in an unconscious state. Two hours after he was brought in his senses returned and he answered questions. At this time the doctor first saw him. He was now in a somnolent condition. He had a compound fracture of the lower jaw. No fractures of the extremities were discovered, but it was noticed when he was roused up he screamed. The vertebrae in the neck were examined, and the spinous process of the fifth cervical was felt completely broken off and easily moved in any direction. His lower extremities were entirely paralyzed. The right arm he swung about, but the left was helpless. He was in great shock. His pulse was quick and irregular and he breathed with deep stertor. His friends would have it that he was not paralyzed, because, they said, "he lay down with a load on," and as soon as he slept it off he would be all right. He died at 7 p. m.

Diagnosis.—Fracture of the spine and probably of the base of the skull, though there were no clear indications of the latter, except the comatose condition. The immediate cause of death was probably hemorrhage into the brain and spinal cord. Without doubt, too, there was hemorrhage from ruptured organs in the abdomen and throat.

Comments.—There was one incident in connection with this case of more than passing importance, and, the role of intoxication played. Pathologically, the case was a mixed one. We can conceive of a person sustaining a similar injury in whom the question of inebriety might constitute the turning point in a suit for damages. Had it not been known that he had gone on the roof and been found in the yard, without a most painstaking investigation it would be difficult to say, had not the fracture of the spine been discovered, whether his injury did not result from a simple fall or from a blow from a club or a sandbag.

Twenty-second Case.—History.—Patient, a vigorous young man of 23. Admitted to Harlem hospital Oct. 13th, 1889. He had been injured four days previously. His occupation was that of a licensed vendor. On the morning of the accident by which he was injured his horse ran away and collided with an ice wagon, when he was thrown to the ground with great force, and, before he could rise or the driver of the ice wagon could stop his horses, both wheels of the wagon passed over our patient's neck while he lay face downward on the stone pavement of the street. He was taken up insensible and brought home. After about three hours consciousness returned. Now he noticed slight dimness of vision, ringing in the ears, numbness in the hands and a "pins and needles" sensation in both feet. His limbs felt heavy and were moved only with difficulty. At night he suffered from his neck, which had been severely crushed and was terribly sensitive. The breathing apparatus and oesophagus had shared in the results of the injury, for swallowing during the first day was quite impossible and his voice was husky. On the third day his symptoms referable to trauma of the cord were not so marked, but his breathing was, with time, becoming worse. Hence, the medical attendant, fearing that acute

traumatic laryngitis might suddenly arise and require for its relief radical surgical measures, sent him, on the fourth day, to the hospital.

Condition on entrance. Head and neck locked; features dusky, husky voice, respiration 26; pulse 122; temperature 101 $\frac{1}{2}$; speaks in a low, stridulous, indistinct voice; the right arm quite powerless, but the left, except for an area on the dorsal aspect of the forearm, in motion normal. He can walk, but says his legs feel heavy, and when he is in bed they often "spring up," through involuntary contraction of the ham strings. His neck is terribly contused and wrenched, so that he can make no move of it without the greatest pain. No fracture can be discovered, although all the spinous processes of the cervical vertebrae are exquisitely sensitive to the least pressure. The most alarming symptoms emanated from the respiratory organs. There had been free hemorrhage into the cellular tissues, the supra and infra hyoid muscles. This had been followed by a large sero-plastic exudate, a sort of inflammatory oedema, which pressed the integuments forward, the larynx and trachea backward.

Diagnosis—Contusion of the cervical segment of the cord, intra-spinal hemorrhage, in small amount, cervical haematomata into the cellular tissues and traumatic laryngitis.

In order to allay all fear from suffocation tracheotomy was recommended to be at once performed. But he declined it, saying that if he got worse it might be done. He seemed somewhat improved with respiration in the evening, but, nevertheless, he was unable to lie down. The house surgeon was warned now to be on the alert for the first symptoms of impending suffocation, and have the laryngeal instruments in reach and to proceed and open the trachea promptly in the event of this contingency. Tuesday evening, the 14th, he was suddenly taken with a strangulation spasm. As the time had arrived for prompt action the house surgeon, for the first time in his life, realizing the magnitude of the operation of tracheotomy, under these circumstances, was for a moment nonplussed and "rattled." He gave the patient a hyperdermic injection of morphine and sent for me. As this was before I was acquainted with the infinite value of cocaine in tracheotomies, great difficulties lay in the way of canalizing the trachea. But it was finally accomplished, when all immediate danger to life passed away. The symptoms emanating from the spinal cord, as revealed through the peripheral nerves, gradually disappeared. But the deafness remained noticeable for some time after the laryngeal wound closed, and he was dismissed from the hospital, which was just three weeks after entrance. I have seen him many times since. His deafness in one ear has remained. This I attribute to hemorrhage into the middle ear, which has become organized and undergone transformation, partly obstructing the sound passage to the labyrinth.

Comments—This case is quite unique in the annals of spinal traumatism. In the thorax and in the abdomen serious contusion of the dorsal or lumbar spine is generally attended by lesion of an internal organ. But laryngeal injuries are very unusual in those traumatism which involve the cervical spine. We may assume with considerable certainty that in this case the traction brought to bear on the spinal cord extended into and through the oblong medulla, the pons and base of the brain. It was singular to note that while the nerves of the extremities were markedly parietic, those branches supplying the sphincters were not involved.

Twenty-third Case—History—Patient admitted to the Harlem hospital on the morning of July 4th, 1892. His age was 43 years, a salesman by occupation. On the night of July 3d patient retired at 11 o'clock. One hour later, while in a somnambulistic state, rose from bed, and while groping about his room fell from an opened window to the ground, a distance of about 15 feet. He was found some hours later where he fell, in an unconscious condition. At the time of admission to the hospital patient was in a conscious state, but he had complete paraplegia, with faecal and urinary incontinence. The urine was highly ammonical. His temperature was 102, pulse 100, weak and compressible. Great pain in the neck and back.

July 10th. General condition bad; has a bed-sore, no power or feeling in the arms. Large bed-sores are formed over the sacrum. Being a heavy man he is handled with difficulty.

July 13th. Morning temperature 105 1-4, pulse 130; delirium; respiration wholly diaphragmatic, quick, gasping and irregular; features deeply cyanotic.

Diagnosis—Hemorrhage into the cervico-dorsal segment of the spinal canal, entirely outside the theca, with consecutive meningo-myelitis, extending into the medulla-oblongata and base of the brain.

On the evening of the 13th, as mucous accumulated in the trachea and he was unable to dislodge it, asphyxia became very distressing and he died at 11 p. m.

Autopsy—We were permitted only to open the spinal canal, over the seat of injury. No fracture of the vertebrae; extensive laceration of muscle, and effusion of blood into all the super-imposed soft parts about the cervical center of the spine. On opening the vertebral canal its interior, outside the dura, was found stuffed with blood of a dark color, in a semi-fluid state. This extended as far upward as the foramen magnum, at which point it was limited by the insertion of the theca into the ridge around this portal. The hemorrhage had wholly escaped through the meningo rachidian vessels, which were found open in different situations. On opening the fibrous envelope of the cord a sero-purulent fluid issued through the incision in the membrane from the arachnoid and subarachnoid cavities. The meninges were extensively adherent along their anterior surfaces. As the weather was very hot and as softening had commenced in the part of the cord exposed, it was found quite impossible to do anything with it, now reduced to the consistence of thick cream.

Comments—Somnambulistic groping is a common phenomenon, but it is unusual that the victims of it expose themselves to danger. It had been reported to us, however, just before he died, that the somnambulistic theory had been suggested by a shrewd female relative; that he had been "celebrating," and, in a fit of the "jim-jams" (delirium tremens), had made a plunge through the open window. This was a typical case of spinal hemorrhage, primary to the fatal meningeal inflammation, which it gave rise to.

Twenty-fourth Case—History—Patient, a physician, age 26, came under my care May 10th, 1889. On the evening of April 29th, eleven days before, the doctor was riding in a tramway, for which cable traction was supplied. With this sort of a motor, unless the "gripman" is experienced and cautious, in starting the car, it goes by a bound. On this occasion the doctor had mounted the car, had nearly reached the center, standing in the aisle between the seats, about to sit down, when the car started with a

lurch forward, and he was thrown backward with great force, the back of his neck and shoulders striking against the seat. A carriage was called and he was sent home. Soon after being placed in bed he had a free pulmonary hemorrhage. In the morning he had a very painful stiff neck, with inability to move his feet and legs. One arm could be raised, but the other was quite powerless from the elbow down, but sensation was little if any affected. Remained in bed for five days. He observed, on the third day, eye and ear disturbances, but with the onset of these the paralysis in the limbs seemed to improve. His attending physicians now applied electricity, with shampooing the spine, etc. When I saw him he was able to walk, if he were supported under either arm pit. Crutches he could not utilize at this time, because it was impossible, with the feeble grip of the hands, to steady or lift them. He had no fever. The pulse was quick and compressible, and his respirations were accelerated to 32 a minute. He was very nervous, because he feared that he had sustained organic injury of the spine and would remain a cripple for life. As it was evident that this case would involve a litigation, a most thorough and exhaustive examination was made of the entire nude body. The details of this examination, though highly interesting and valuable, are too full for the space at my command at present, and hence but a few of them will be noted.

Circulation—Heart's action tumultuous, though regular; pulse 122 standing, 110 sitting; hands and feet cool; skin of the face and hands pale; lips, ears and nose of an ashy white; temperature 98.3-4; reflexes normal, except at the ankle joints, where there was a marked diminution in response to percussion.

Muscular Tone—The muscles were wanting in that firm, elastic quality belonging to health.

Kidneys—Urine, reaction acid, quantity below normal, sp. gr. 1022. No blood corpuscles found under the microscope.

Lungs—Limitation of the scapular movement on the right side. Absence of vocal fremitus at the base of the right lung. Absence of respiratory murmur, or bronchial breathing. This extended as far up as the nipple line. Left lung normal.

Cerebro-Spinal System—Pupils dilated and only sluggishly respond to light. Hearing normal. Neck and head locked by muscular rigidity. Paresis in lower limbs. Arms rapidly improving. A marked hysterical element present.

Diagnosis—Contusion of the spinal cord and base of the brain. Myopathic complications in the posterior cervical muscles, attended with trophic changes. Traumatic subacute pleurisy, with unabsorbed residue, remaining. Spinal hemorrhage with mild type of meningitis.

Comments—The doctor, after an invalidism of about three months quite recovered, though for more than a year he felt rather unsteady in the limbs. But he finally became perfectly well. At the present time he is a ship surgeon, sailing between New York and Antwerp.

This case presents several interesting features. To commence, he had a rather feeble physique; was hysterical in a marked degree. This had been the bane of his life. The primary injury extended further down than any of the preceding, into the thorax, inflicting damage to the pulmonary tissues. His recovery, though slow, as might be expected with one of his physique and temperament, was, nevertheless, complete, and

none of his nervous phenomena ever relapsed which had appeared with his injury.

Twenty-fifth Case—History—J. W. J., aged 33 years, bricklayer. Early on the morning of Aug. 1st, 1892, patient, while under the influence of liquor, on descending a flight of stairs, lost his footing and fell heavily forward on his neck and shoulders. Was admitted to the hospital two hours later. He now has complete paraplegia, the paralytic area extending nearly as high as the cervico-dorsal junction. It was not so pronounced in the upper regions of the trunk as lower down. The motor type of paralysis was clearest indicated. Rectal and vesical incontinence complete. On the third day after admission temperature 101 1-4, pulse 104. Vaso-motor paralysis in the peripheral vessels of the face and neck. Features covered by a dusky congestion; no cephalic complication; head and neck fixed by spasm of the cervical muscles of the spine. Lies on his back continuously. Complains only of pain in his neck. Irregular, spasmodic action in the muscles of the legs and thighs; bed-sores forming over the sacrum, the heels and occiput. Continued in practically the same condition until Aug. 9th, when he commenced to show signs of improvement.

Diagnosis—Intra-spinal hemorrhage, contusion of the spinal cord, consecutive spinal meningitis, paraplegic and symmetrical paralysis of the trunk.

Comments—The first and most obvious symptoms of improvement in this case were discontinuance of the incontinence and healthy appearance of the decubital sore. The return of function in the paralysed limbs was slow but steady. The recovery of power in the arms was tedious. And when he left the hospital Sept. 28th, about nine weeks after entry, he could not yet raise the right hand above the head. At this time his left arm hung powerless at his side, though he had sensation in it and could move the fingers slightly. He returned to the out-patient department for treatment twice a week for four months, at the end of which time he had fair use of both arms. He last reported March 12th, 1893, at which time he said he felt quite as well as usual and was going to work the following day at his trade. In this case, as in all other lesions of the spinal cord from violence, it has been invariably noticed that sensation is the first to return after the succeeding paralysis. Indeed, in quite a number, while the motor reflexes were in complete abeyance sensation, though diminished, was intact. The muscular atrophy in this case was very rapid after injury and all the joint prominences gave an appearance of arthritic hypertrophy. The large bed-sore was a great source of annoyance and was nearly six months in healing after he left the hospital. This was another case of typical spinal hemorrhage, one of the very few of which when meningeal inflammation follows it fails to extend into the base of the brain and cause death by inhibition of the respiratory and cardiac reflexes. It did not appear that it spread upward beyond the fifth cervical vertebra, as at no time was there diaphragmatic breathing or implication of the thoracic or prencic nerves. This was a case of the most aggravated type of spinal injury from concussive force except those of a mortal character, and yet our patient's recovery was quite complete.

PUNCTURED WOUNDS OF CORD AND SPINAL STRUCTURES.

Twenty-sixth Case—History—Patient admitted into Ninety-ninth Street Hospital July 14th, 1886, Italian laborer, age 41 years. Was injured on

the morning of this date in a brawl with the men employed with him in excavating. A pick axe was hurled at him, the point striking a little to the left of the median line posteriorly and knocking him down. He raised himself, but fell again after being struck. An ambulance was now called and he was sent to the hospital.

Condition on Admission—Intellectual activity unimpaired. Was bleeding freely from the wound in the neck. The point of the axe had penetrated fully an inch a little to the side of the transverse process of the sixth cervical vertebra, taking an inward and downward direction. The puncture gave issue to very free hemorrhage, so that when he came in his shirt and vest were saturated with blood and he was deathly pale. Pulse was 124; temperature —. Had great thirst and vomited. Great pain in the neck, head fixed. At this time there was no evidence of fracture of the spine or injury to the cord, as there was no paralysis. The wound was now thoroughly cleansed and dressed and the neck adjusted in a cuirass. The next day temperature 100, pulse 112; now has numbness in hands and cannot move the right fore arm. Wound rendered aseptic and closing in. More or less tumefaction of the entire neck posteriorly.

General condition after the fourth day. Paralytic symptoms began to subside in the arms. The legs were at no time affected as far as we could learn. As he spoke only broken English it was difficult to elicit much from him except through objective symptoms.

Diagnosis—Punctured wound of the neck over the spine, laceration of nerves and contusion of the spinal cord.

His recovery was rapid and complete and he left the hospital to return to work after two weeks.

Comments—The special features of interest in this case are of an aetiological character. First, with reference to the cause of shock, great prostration and surface exsanguination; whether they arose from contusion of the spinal cord and partial suspension of animation or loss of blood? As a general rule punctured wounds do not bleed excessively. In this case, however, the loss of blood was quite considerable. My impression is that the temporary palsy of the upper extremities was attributable to a propagation of the inflammatory processes from the damaged nerve trunks through their sheaths to the meninges and medullary substance. Why it did not generalize and spread toward the brain or spread downwards is not clear, except that which is in accordance with what is so commonly observed in traumatic injury elsewhere, when in one perhaps it limits itself alone to the immediate area involved. The spinal cord injury in this case was not primary and depending on contusion, but rather attributable to secondary inflammatory processes.

Twenty-seventh Case—History—Patient, an Italian, aged 27 years. Admitted to Harlem hospital Dec. 12th, 1890. This young man, with several of his countrymen on a Sunday afternoon had a free fight in a liquor saloon, during which his adversary drew a stiletto—a sort of bayonet-shaped weapon—and plunged it several times into our patient's back and side as he was trying to escape through a back door. When the ambulance arrived for him he was bleeding profusely from the wounds, especially one which had been inflicted in a downward direction from the head to the spine over the course of occipital artery. He was greatly exsanguinated when the ambulance surgeon arrived, who dressed the wounds and prepared him for the journey to the hospital, which was about one mile

distant. The puncture in the cervical wound now commenced to bleed after he had rallied from the shock, which was only subdued by firm digital pressure over the opening continued by the house staff and nurses in turn for nearly five hours. The following afternoon he was seen by me for the first time. Now he was very weak. His pulse was 130, temperature 102 1-2. He had five wounds in all. Three of them had entered the fleshy part of the back and seemed superficial. One of them just to the inner side of the spinal border of the scapula in its lower third. It was evident that this had penetrated the lung, for there was a large sanguineous effusion into the right pleural cavity, and besides he had expectorated blood during the first night in the hospital. The house surgeon had immobilized the head and neck, as he found by doing this the patient had the most comfort, and it favored the control of hemorrhage from the wound, which had penetrated from above downward through muscular tissues in the occipito cervical region. There was now no tumefaction of the supra-spinal tissues, but the neck was terribly intolerant to pressure and he screamed on the slightest movement of it. There was well marked paralysis of the right arm, both of sensation and motion. Besides, though he could move the left arm to a certain extent, sensation was greatly diminished. Complained of numbness in the feet, though he was able to move them. What we could elicit from this man would have been very unreliable, were it not that an Italian-American boy, who lay in the bed next to him with a fractured leg, served us admirably as a most useful interpreter. He remained in about the same condition without much change except in the injured side. He had a septic pleuro pneumonia for two weeks, when he began to improve in his general condition and in the paralysis, which by this time had quite vanished. He could now move his head and neck with facility and turn on his side in bed.

Diagnosis—Punctured wounds of the lung and spinal cord, consecutive pleuro-pneumonia, subdural and epidural hemorrhage of the spinal cord.

This man made a very slow recovery from the wound in the lung. He was very feeble from the excessive loss of blood, therefore his recovery was tedious. He remained in the hospital two months. But he has since recovered perfect health and follows the trade of a fresco painter.

Comments—Inasmuch as this man sustained a great loss of blood and there was great bodily prostration it might be questioned whether his spinal cord was injured in any way by the blade or the point of the weapon; and if it were in this vital part of the cord, its effects, one would suppose, must have been immediately fatal or we should have a septic meningitis, as he had septic infection with the other serous membrane, the pleura. It must be confessed that if we did not have an interpreter we would have been in doubt, as we had no physical phenomena to demonstrate the existence of cord injury. But my experimental work on the lower animals has repeatedly demonstrated that the puncture of the cord, even with a large bradawl, is by no means fatal, and that they usually survive them without any evil consequences beyond a slight temporary paralysis, unless there has been extensive laceration. As to septic infection, it is possible before the wound in the neck had been inflicted he had "fleshed the blade" with previous stabs, and it was sent warm and dripping into the tissue of the neck uncontaminated. Owing to the imbricated arrangements of the bony coverings of the cord it is just possible that the blade did not enter the canal, but as is supposed in the preceding case functional

derangement in the nerve supply to the extremities was caused by the propagation of an irritation inward to the cord along the nerve roots which was reflected in a centripetal direction by the peripheral nerves to the extremities.

GENERAL SUMMARY ON LESIONS OF THE CERVICAL SEGMENT OR THE SPINAL CORD IN MAN.

These twenty-three cases include all my personal experience with cases of traumatism of the spine in which the symptoms clearly indicated that the maximum of force had been sustained by that part of the spinal cord ensheathed by the cervical vertebrae. More than as many more have come under my care in which the injuries borne were purely extrensic, without any direct central complication at the time of accident, though at a later date in some they appeared. In a large number of cervical injuries, in compression from bone fracture and those so-called cases of "concussion of the brain," which have promptly succumbed after injury or recovered, in many the neck has been violently wrenched and I suppose the enclosed cord has very often sustained positive coincident lesions. In fact in nearly all those injuries to the encephalon from concussive forces or indirect violence the cervical segment of the cord cannot entirely escape. A consideration of both of these classes would include a large number of cases which would hardly come within the scope this review.

CASES IN WHICH THE LESIONS OF THE SPINE WERE IN THE CERVICO-DORSAL, DORSO-LUMBAR AND SACRAL REGIONS.

Twenty-Eighth Case—History—Patient 46 years old, in previous good health, on the night of July 14th, 1879, while somewhat under the influence of liquor and while asleep in a chair near an open low-silled window, fell through it to the street below, a distance of eighteen feet. As he fell his back came first in contact with the cutting edges of the curb stone, which was much higher than the center of the sidewalk which was not flagged. After he struck the ground he woke up, but was unable to place his feet under him. He was discovered soon after the fall, when he was brought in and placed in bed. Now he complained of a great pain in the back. Has complete paraplegia. Remained in about the same condition for six weeks. As he was a heavy man and incontinence was complete, his thighs and buttocks were one mass of eczematous sores, besides he had a very large, deep, foul smelling bedsore over the sacrum. Now that he had emaciated considerably the spinal apophyses stood out so that it was quite easy to distinguish them and ascertain any abnormal mobility. The spinous process of the 10th dorsal vertebra at this date could be so readily moved in any direction that it was evident it had been fractured.

Diagnosis—Fracture of spine, hemorrhage into the spinal canal, consecutive meningo-myelitis.

This man lingered for nearly ten weeks without any improvement in the paraplegic symptoms when signs of ascending meningitis commenced to make their appearance manifest by the participation of the hands and

arms and by the girdle symptom and disturbance of the respiratory movement which at this time was mostly diaphragmatic. Patient by the middle of October was greatly emaciated. He had developed double pyelitis and had indubitable symptoms of blood poisoning from infection. He died Oct. 27th rather from general constitutional disturbances than the primary injury to the spinal cord.

Autopsy—Twenty-four hours after death a *post mortem* examination was made when we were permitted to open only the spinal canal over the seat of injury. This had to be performed hurriedly in a rather dark room without ample assistance. The entire posterior arch of the tenth dorsal vertebra was found fractured close to the roots of the transverse processes. No displacement; free hemorrhage now partly organized in the spinal canal; cord soft and infiltrated with a haematin staining; extensive meningeal inflammation. An examination in detail of the parts was impossible.

Comments—This patient lingered a long time after the primary injury and death finally was brought about by a mixed condition of paralysis and septic infection, the latter through the urinary passages and the bed-sore.

Twenty-ninth Case—History—Patient 64 years old, general health fair. He came under my care in my service in the surgical division of the Almshouse hospital on Blackwell's Island, March 2d, 1884. Patient had been out at work with a gang of men employed in constructing a stone wall for a cellar when through the carelessness of other workman he was struck violently on the back between the shoulders by a large piece of a green spruce beam which had fallen end forward from an embankment nearly twenty feet high. He was standing nearly straight at the time of the accident and was thrown forward on his face. Being unable to rise he was lifted onto a stretcher and brought to the hospital. The next day he was seen by me. At this time he had no raise of temperature, but he was very weak. Through the preceding night he had raised pure blood with his sputa.

Condition—Well marked, though not complete, paralysis in the extremities. The right leg was quite powerless, while with the left, though there was some motion at the ankle joint he was unable to flex the knee. There was numbness in both hands and there was little or no grip power. Complained of a severe "grinding" pain in the back. At the point of injury over the third, fourth and fifth dorsal vertebrae there was a large patch of discoloration of the integument. There was no symptom of fracture of the spine, no rectal or vesical incontinence. On careful physical examination of the thorax there was no evidence of traumatic lesion of the parenchyma or serous envelopes of the pulmonary organs.

Diagnosis—Violent concussion of the entire trunk, with contusion of the spinal cord, probable moderate extra thecal hemorrhage.

The paralytic symptoms made little or no advancement, though they were slow in yielding. Hence to avoid a bed-sore great pains had to be taken in the nursing by keeping him turned from one side to another with bathing, etc. He had a sharp febrile attack on the 12th day of May, but as it made no impression on the paralytic symptoms and was distinctly intermittent, a few full doses of quinine dissipating it. He remained feeble he had so far recovered as to be able to get up. He remained feeble

through the summer, though he finally fairly recovered. He died the following spring suddenly of a thoracic aneurism which was seated in the innominate artery.

Comments—There is nothing of special interest to note in this case except that paralytic symptoms made no advance. Had this aneurism bursted by a *centre coup* force, by a blow on the back at the time of accident it is just possible that the thorax would not have been opened *post mortem* the rachidian parts alone being exposed, and the case would have been set down as death from "concussion of the spine." As it was on *post mortem* examination a year after the injury no spinal lesions were discovered.

Thirtieth Case—History—M. J., age 27 years, seen by me May 20th, 1886. While intoxicated he fell into an open bulkhead, falling about eleven feet, striking with his full weight onto a block over the mid-dorsal region. He lay there unable to rise until early in the morning, when by his cries he attracted the notice of the police, at which time he was raised from the pit into which he had fallen and was carried to his home, which was near by. I saw him the day after the injury. As he had been drinking heavily it was thought that when he would sober off he might survive, what the police facetiously dubbed his "rum paralysis." But he did not, on the contrary the following day he was more helpless than ever. At this time there was no elevation of temperature. The pulse was rather accelerated. He complained of great pain in the back and was disposed to vomit. Paraplegic partly, though there was no incontinence. Upper extremities not affected. The following day paraplegia more distinct. The bladder had become paralyzed, as he was now unable to void his urine. The urine, which was slightly ammoniacal, was withdrawn four times in every twenty-four hours for four days. After this he could urinate of his own will.

Diagnosis—Contusion of the spinal cord, spinal hemorrhage, paraplegia, consecutive to hydrostatic pressure.

There were symptoms of abatement of paralysis on the eleventh day after injury. Improvement was rapid and continuous after this date. Six weeks after injury he was able to move about with the aid of crutches. He finally made a good recovery.

Comments—There is a general impression among the laity that one falling in a drunken state is less liable to sustain severe injury than when sober. In my experience this notion is not with some foundation. It is certainly true that the shafts of bones resist fracture better in the inebriated. There is a scientific explanation for this. The drunken man is unconscious of danger and his muscles are in a relaxed state, so that when he tumbles he does so in a heap, so that this etiological element in fracture of muscular contraction is wanting. But in spinal and cranial fractures the man stupified with alcohol is rendered more prone and susceptible to injury by long odd than are others.

Thirty-first Case—History—Patient nineteen years of age, female. Was called to see in consultation to Yonkers. Found a homeopathic physician in attendance. The young lady was seen by me May 7th, 1888. Ten days before I saw her while skating in a skating rink, moving in a circle at a rapid rate of speed, she was tripped and thrown in a sort of rotatory motion of her body with great force on her back, striking just below the scapulae. She was greatly shaken by the violence of the fall and was able to rise only after nearly an hour from the bench on which she was tem-

porarily lain. But she did take her feet after a time and walked home with her male escort, a distance of about half a mile. Was up about the next day, though she had very severe pain all over the back. Continued up every day until the evening of the fifth day, when she had a severe chill, followed by a stiffness in the muscles of the neck and loins, besides with a pricking sensation as though the soles were "asleep," losing the power in her hands. Had great thirst and general bodily weakness. Continued becoming worse from day to day until the time I was sent for.

Condition on tenth day after injury. Patient lay on her back in opisthonos, contracted state of the cervical muscles. This tetanic state involved no other muscle group. Lower jaw moved freely, no impediment to swallowing. Face flushed, tongue caked, center and edges red, great thirst, respiration 42 per minute, pulse 130, temperature 103; great tenderness over the entire spine. Violent racking pain in the back, for which our champion of "infinitesimal dosage" had been administering scruple doses of potassium, bromide and quarter grain hypodermic injections of morphine every two hours. Mind clear and unclouded, but she was in great mental distress and begged to have her life saved. Paralysis of the extremities; the special senses not involved; incontinence of the rectum; complaints of great pain in the hypogastrium. On examination over this region it was found that there was a great vesical distension. On introduction of a catheter nearly three quarts of urine were drained away, greatly to her relief. There was almost constantly more or less involuntary convulsive action in the flexor muscles of both extremities.

Diagnosis—Traumatic acute general spinal meningitis.

Prognosis—Very bad, as inflammatory processes had advanced upward and involved the nerve roots and ganglia of the respiratory centers, and and involved the nerve roots and ganglia of the respiratory centers, and she was being slowly asphyxiated. She died the same evening, a little after midnight.

Comments—The most noticeable features in this case were:

First, the rather late date at which meningeal inflammation followed after the accident.

Second, the probable actiological factors in the outset.

As an autopsy was not had in this case it was impossible to definitely determine the original pathological changes. The case certainly did not present the typical features so characteristic of hemorrhagic meningitis of the spine. My impression is that it is one of that class sometimes seen in a delicate, strumous young female, in which the inflammatory changes had their starting point in a general commotion of the spinal cord.

Thirty-second Case—History—Patient, 41 years old, brought into the Ninety-ninth street hospital June 20th, 1885. On the morning of that date patient, while in a stooping posture, at work in sinking a sewer, one of the side supports of the bank gave way and he was struck on the middle of the back by a mass of earth and a boulder. The material which caught him was quickly removed, when he was extricated. He was suffering great pain and shock. Stimulents were given him, and when the ambulance arrived he was carefully examined, temporary dressings applied, and he was removed to the hospital. On careful examination in the hospital it was found that he had fractured the sixth and seventh ribs at their posterior angles. There was at this time no paralysis. The following day he was unable to move the lower extremities. No incontinence, no frac-

ture of the spine; temperature 101, pulse 112; severe pain in the back and right side. Paraplegia continued without any change for four days, when he commenced to move the limbs. Some pleuritic friction over the site of fractured ribs. Continued to improve. After three weeks recovered full use of lower extremities and left, quite restored in health, though yet weak in the legs, after six weeks in the hospital.

Diagnosis—Fracture of the ribs, contusion of the spinal cord, with moderate extra thecal hemorrhage.

Comments—Costal fracture is not an uncommon complication in traumatism of the spine in the dorsal region. The ribs are essentially a prolongation, jointed, of the transverse processes. But they contribute to the dorsal spine a lateral support, wanting above and below, hence the reason that this region is so free from the effects of that twisting, cork-screw motion so common in lesions of the cervical or lumbar regions.

Thirty-third Case—History—Patient, 30 years old, a male prisoner, came under my care in the workhouse hospital of New York May 12th, 1883. Patient was injured ten days previously by a police officer while he was resisting arrest. It occurred in the night when the night patrol carry heavy, three-feet long hickory or locust clubs. He was beaten violently over the back and hips before he yielded. Now he was locked up and lay all night on the damp, cold floor of his cell. The next morning he could hardly rise to walk the lower limbs were so weak. He was now dragged to court and sentenced to the "island" for three months. When he arrived there the examining physician sent him to the hospital. When I saw him he had paraplegia, though not fully developed. There was no rectal incontinence, though his urine had to be drawn with the catheter. Temperature 99 1-4, pulse 112. Had expectorated pure blood freely. Continued in about the same condition for two weeks, when he commenced to improve. He remained on Blackwell Island two weeks after his time was out and left on crutches. His paraplegia had practically disappeared, though muscular atrophy and weakness of the limbs remained. On a most careful examination no fracture could be found on entry, though the back was one mass of bruises.

Diagnosis—Contusion of the spine from violent clubbing, subacute spinal meningitis, with consecutive, incomplete paraplegia.

Comments—This was the only case of this character that I have ever seen from a policeman's club, though we do see skulls shattered by it and the limbs fractured. Violent, concussive, repeated shocks over the spine had induced, no doubt, a peripheral meningeal hemorrhage, which, in him, had given rise to a low grade of inflammation and paralysis of the lower extremities. We never heard from this prisoner after he left the hospital.

Thirty-fourth Case—History—Patient, American, 52 years old, fell three stories into a back yard. This woman was admitted into the Ninety-ninth street hospital on Aug. 24th, 1885. Patient was engaged in the morning hanging out clothes. She stood on a fire escape just outside her window, on the fourth floor of a tenement house. As one of the pulleys on which one end of the clothes line played in some way failed to work she bent over the fire escape, pulling the line with all her strength, in a downward direction, in this manner hoping to free the fixed end. But this tension was too much, for it and the line gave way, when our unfortunate patient went downward into the yard, in her descent striking with great force on

the sharp edge of a rail of a fence in the middle of her back. She was raised in an unconscious condition. When the ambulance arrived she was in great shock. Shortly after her arrival at the hospital I saw her. Was now unconscious; had free hemorrhage from her mouth and was deathly pale; Pulse was exceeding rapid and feeble; a cold, clammy perspiration bedewed the surface of the body; extremities cold; in fact she was practically moribund. On examination of the spine a fracture was discovered which involved the transverse processes of the seventh and eighth dorsal vertebrae. Complete paraplegia. She had great pain through the abdomen, extending up over the cardiac region.

Diagnosis—Fracture of the spine, spinal hemorrhage, paraplegia from hemorrhagic pressure, internal injury.

Our patient never reacted and died in shock six hours after admission, of exhaustion. A *post mortem* examination was denied.

Thirty-fifth Case—History—Patient, an Italian, 40 years old, admitted into Ninety-ninth street hospital May 31st, 1884. He was injured in the back by a falling wall, which was being pulled down, and was crushed by the debris. He was in a stooping posture at the time of injury. When he was lifted out there was great pain in the back. His back was cut and badly bruised by the falling of brick and timber, so that his shirt was torn, and over the back was saturated with blood. He came under my notice six hours after admission. Now he was in a very precarious state. His pulse was thready and rapid, 140; temperature was subnormal; had vomited blood freely; is deathly pale, extremities cold. On examination of the spinal column no fracture could be made out, but there was an abnormal convexity in the mid-dorsal region suggestive of former Pott's disease. Complete paraplegia, with paralysis, as far up as the nipple line, faecal and urinary incontinence, respirations very rapid and evidently painful.

Diagnosis—Spinal hemorrhage, contusion of the spinal cord, hemorrhage into the stomach.

Patient continued in about the same condition until the fourth day, when the temperature went up to 104 3-4 and active delirium developed. At this time both arms were quite powerless. It was evident at this period that inflammatory processes had extended into the superior segment of the cord and the base of the brain. He died in the evening of the fourth day, sinking from asphyxia attributable to respiratory inhibition.

Post Mortem Examination—As consent was not obtained to perform a full autopsy, we ventured only to open the spinal canal. Here, over the seat of injury, blood was found effused into the soft parts in great quantities. The muscles were lacerated and contused down to the vertebral column. No fracture, extensive effusion of venous blood, extending into the theca, no meningeal nor medullary hemorrhages; extensive meningitis, which had been propagated, as far up as could be traced, in the spinal canal.

Comments—This case clearly belonged to the same category as many others, in which *extra dural* hemorrhage, by its quantity and pressure had excited a fatal meningitis.

Thirty-sixth Case—History—Patient, a hod carrier, aged 26 years. On the afternoon of July 14th, 1889, patient, while wheeling brick on a staging about 40 feet from the ground, upset his barrow load of brick, and, with it, tumbled over the staging to the earth. He was taken up in an

unconscious state and brought home. Dr. George E. Hubbard was called to see him, and, seeing that the case was a grave one, advised consultation and sent for me, to see it with him, in the evening. He was now in a semi-comatose condition, but on pricking the integument the reflexes responded. What was most remarkable was the very high temperature, as it now registered 107 degrees in the axilla. Was he suffering from isolation? It was said that he drank beer previously, during the afternoon, which was very hot. On examining the back, over the lower dorsal region, there was found a large excoriation over the integument, but no evidence of vertebral injury. We decided that the cerebral symptoms were attributable to sunstroke, and that he probably fell while suddenly overcome with vertigo. Iced applications were freely used, externally, and iced enemata were given internally. After midnight he commenced to improve. In the morning his general condition was very good, but he had complete paraplegia. He remained under medical care for nearly a month. He made very slow recovery from this paraplegia and was unable to do any work for nearly a year. But he ultimately entirely recovered.

Diagnosis—Paraplegia induced by insolation, traumatism of the spine probably but a coincident factor.

Comments—This case was an unusually interesting one, from the etiological standpoint, inasmuch as it was quite impossible to determine just what share the traumatism had in producing his paralytic symptoms. I have witnessed paraplegia in several cases of insolation which persisted in varying degrees after the patient took his feet. The builder was threatened with a suit, as it had been claimed that the staging was defective; but he escaped by proving that the man had sunstroke and by claiming that he was not responsible for the weather. A medical man of distinction had suggested to me whether the high temperature might not have been attributable rather to an injury of the thermogenetic centers of the spine than to the weather, but there was nothing to support this view, either in the clinical history or the ultimate termination of the case.

Thirty-seventh Case—History—Patient, a young man of 21 years, entered the surgical section of the "out-patient department" of the Harlem hospital May 17th, 1889, into the service of Dr. A. J. Fitzgerald. Patient came there using a cane and crutch in walking. He said that two weeks before, while swinging with another, he lost his hold on the rope and fell with considerable force, striking on the shoulders and scapula. The fall, he said, gave him quite a shock, but he was able to rise and make his way home unassisted. He remained about the house for nearly a week, suffering meanwhile from severe pains in the back and loins. On the eighth day after the injury he was aware for the first time that he had paralysis in the feet and legs, for he noticed a numbness in the soles, and, in standing, he had to seize something for lateral support. In trying to walk he threw his legs forward, rather than lifted them. On examination of the spine there yet remained the discoloration from the effects of the fall, on the mid-dorsal region. The spine here was very sensitive and the soft parts tumefied. The grip of the hand was quite feeble. The general condition was very good. He had a chancre some month before, which, from the description and ultimate history of it, would point to its non-constitutional origin.

Diagnosis—Contusion of spinal cord, laceration of meninges and medullary substance, consecutive, subacute spinal meningitis and moderate paralysis.

At the time patient was sent to us from the dispensary he was improving under appropriate treatment, and in one month he was quite restored and returned to his work as a clerk.

Comments—The only dubitable question in this case was as to whether this young man was not suffering from a spinal disturbance the pathology of which was rather dependent on syphilitic disease than the trauma, which might have been but an aggravating element. He had no positive symptoms of fibrosis of the posterior cornua. He was too young for such a disease. However, when placed under full doses of mercury and iodide of potash, he made rapid progress, lost the pain in the back and recovered the full use of his limbs.

Thirty-eighth Case—History—Patient, a female, aged 25 years, was injured April 20th, 1889, by falling into a pit while crossing a lot during a dark night. She fell about five feet and struck on the rock bottom squarely on her back. She lay helpless for nearly an hour before she was able to make outcries and receive succor. She was brought home and placed in bed. Had great pains in the back. In the morning Dr. B. Shehan saw her, when she had numbness in the feet and was unable to raise her knees. Mild paraplegia continued for a long time, and it was several months before she could walk. But it was noticed that when she commenced to walk that she had a feeling of "falling in" in the upper thorax, so that standing or sitting was quite impossible without a Sayre jacket or some sort of a brace to substitute the weakened muscles of the spine. Fourteen months after the injury I was called in to see her with Dr. Shehan.

I found then that she had practically recovered from the paraplegic condition, but had yet great muscular weakness in all the spinal muscles. The lateral walls of the chest were quite anaesthetic and there were unmistakable signs of muscular wasting. There was no evidence of bone lesion of the spine. No mental or physical phenomena, except from apprehension that she would not recover.

Diagnosis—Subacute meningitis interfering with the nutrition of the cord, occurring in consequence of primary spinal hemorrhage and spinal contusion.

Comments—We heard from her a year later that her spine was yet weak, but she worked at dressmaking, having yet to use the plaster corset.

Thirty-ninth Case—History—Patient 28 years old, a lineman for a telegraph construction company, admitted to Ninety-ninth Street hospital July 2d, 1885. Patient was astride a cross piece on a telegraph pole when his hold slipped and fell a distance of about thirty-five feet, striking on his back. He was so shaken by the fall as to be unable to rise. A passing police officer signalled the ambulance and he was brought to the hospital. He was suffering moderately from the shock on admission. Had fractured the right humerus near the shoulder. Has severe pain in the lower dorsal region. Unable to urinate. Blood-stained urine drawn away. No rectal incontinence. No paraplegia developed, but on the fourth day after admission began to lose sensation and power in right hand. Paralysis was never complete here and after a week commenced to abate. It was ten

days, however, before the detrusor urinae regained full power and was able to empty the bladder.

Diagnosis—Concussion of the entire body and of the spinal cord with meningitis in the lumbar region affecting the lumbar ganglia of the cord, aquina and the roots of the four lower cervical and first dorsal nerves.

Comments—The aberrant type of palsy following this injury was most unusual and remarkable. The kidney had been contused, but not extensively lacerated. The young man left the hospital two weeks after entrance and returned to work quite restored in health six weeks after injury.

Fortieth Case—History—Patient 42 years old, entered Ninety-ninth Street hospital dispensary Aug. 6th, 1885. Patient one morning, four weeks before admission, was kicked between the shoulders and knocked down by a new horse which he had bought the day before. He was standing with his back to the stall about three feet from the horse's hind legs, and when struck was thrown forward on his face and hands. After a few moments he was able to rise, but the pain in the back was so great that he was obliged to go home and lie in bed all day. About four days after the accident he notice the first signs of paralysis in the lower extremities, which had become weak and partly anaesthetic. After this he could only walk by the aid of crutches for two weeks, and then with a cane. He came into the dispensary four weeks after the accident for electrical treatment to the paraplegic limb. On examination a large patch of discoloration was seen which was situated rather to the left side at the inner inferior angle of the right scapula. Placing him on his back and straightening the legs on the thighs with very little pressure on the patella he was unable to flex the knees, and on flexing them there was but very little extension power. Muscular atrophy and atrophic changes in the legs and thighs were well marked. His general health was good.

Diagnosis—Primary extra thecal hemorrhage from concussive violence, consecutive meningitis and partial paraplegia from blood pressure on the cord.

This man came occasionally to the dispensary for two months when with the treatment instituted he was able to move about as usual. I have seen him casually at different times since in the enjoyment of good health.

Comments—It was remarkable in this case that there was no incontinence, while the affection involving the nerve supply of the extremities was so evident.

Forty-first Case—History—Patient aged 48 years, admitted to the Harlem hospital Jan. 14th, 1889. Having been on a "booze" during the day in the evening while sitting near his back parlor window he went asleep and fell backward into the yard, the surface of which was flagged with stone. He lay there till morning, when assistance came and a physician was called. As spinal injury was discovered he was sent to the hospital. When brought in it was uncertain whether he was comatose from injury to the brain or alcohol, for he was now unconscious. On the 15th (the following day) he regained his senses, but had no recollection as to how he had been injured. Rectal and vessical incontinence were now noticeable, and the urine had to be withdrawn by a catheter. Had great pain in the back. On this date temperature was 99 1-4 degrees and pulse 116. Over the spine in the middle of the scapulae there was an abrasion and discolored tumefaction of the integuments.

Diagnosis—Spinal hemorrhage, paraplegia from extra thecal hemorrhagic pressure.

This man showed marked signs of rapid improvement and left the hospital July 9th. He ultimately made a perfect recovery, being able to resume his usual occupation of a clerk after five weeks from date of injury.

Forty-second Case—History—Patient, aged 26, admitted to Harlem hospital Nov. 4th, 1889. This man, while driving, seated on a load of wooden boxes, as he was approaching a railroad tunnel, the horses took fright and he was crushed between the roof or dome of the tunnel and his seat, then rolled off over the wheel forward and fell to the ground. When admitted to the hospital had great pain in the back, paralysis in both lower extremities and incontinence of urine and faeces.

Nov. 5th. Has great distress over the entire trunk and loudly complains of something tightly compressing him over the epigastrium. Temperature 102, pulse 128, respirations 50.

Nov. 6th. Condition about the same. Has that intense congestion of the features which always accompanies grave spinal injuries.

Nov. 9th. Has a large bed-sore over the sacrum and smaller ones over each heel. He is now in great physical and mental distress. Temperature 104, pulse 132, respiration wholly diaphragmatic, abdomen greatly distended. He lingered, becoming daily weaker, until Dec. 3d. On the morning of this day temperature 106 degrees, pulse 150. In a delirious state. Died of exhaustion and asphyxia in the evening. It may be added that on the most thorough examination of the spine no fracture could be made out. Over the middle dorsal region there was a large tumefaction and discoloration, but nothing more.

Diagnosis—Large, extra thecal hemorrhage, consecutive general meningitis, paralysis, with internal organic changes.

Comments—This case was another of that type in which the spine sustains mortal violence without dislocation or fracture, and in which the fatal pathological changes are chiefly attributable to voluminous hemorrhagic pressure.

Post mortem examination was not permitted.

Forty-third Case—History—Patient admitted to Harlem hospital Dec. 26th, 1889. Age, 30 years on the evening before. After he had been drinking patient boarded a street car, mounting the front platform. The car, in making a curve at a rapid rate of speed, gave a lurch and he went off, landing some yards away on his shoulders and back. When he was first admitted to the hospital it was impossible to say whether the fall or alcohol was accountable for his condition. But after a few hours it was apparent that the spine had been severely injured.

Dec. 27th. Temperature 100 1-2, pulse 122; great pain in the back; complete paraplegia; rectal and vesical incontinence. On examination of the vertebral column a fracture of the spinous process was discovered of the ninth dorsal vertebra. There was evidence of effusion into the right pleural cavity.

Diagnosis—Fracture of the spine, spinal hemorrhages, consecutive meningitis and paralysis.

Continued to grow worse from day to day until Dec. 30th, when the temperature had ascended to 104 3-4, pulse 132, respirations entirely dia-

phragmatic, rapid and shallow, deep congestion of the face, inability to expectorate; had active delirium, is restless and almost constantly screaming for the next fourteen days, when he died.

Post Mortem Examination—Autopsy was made twenty-four hours after death. There was nothing of special note in the abdominal viscera. The right pleural cavity was filled with a sero-sanguinolent effusion. The lung was carnified and pressed far upward on the same side where both the costal and pulmonary reflexions of the pleura were adherent by a thick layer of lymph. Now the spinal canal was exposed from the sacrum to the atlas. The posterior arch of the ninth dorsal vertebra was fractured off on either side, close with the roots of the transverse process. This had been rotated partly inward on the cord, but it did not lacerate the theca. A large blood clot was found between the theca and the vertebral walls. This extended down for more than an inch over the corda-equina and upward as far as the fourth dorsal. On opening the dura mater a sero-purulent material freely escaped, which evidently was mostly made up of serum and inflammatory lymph. The meninges were everywhere adherent by a thick, plastic material, which, between the dura and arachnoid, permitted of their separation; but so firmly glued together were the arachnoid and pia that they could not be isolated. The cord was everywhere softened, and, as in the other cases cited, was very deeply stained over the traumatized region. On removing the calvaria the vessels in the arachnoid and convolutions of the brain were seen much distended, and at the base conclusive traces of a recent meningitis were seen.

Comments—It was most remarkable in this case that so much damage should be inflicted on the spine by a fall of the description sustained. He was a very heavy, corpulent man; besides, it is very probable that when he was thrown off the car, the center of the back came in contact with a jutting boulder of rock, or some other hard substance, which crushed in the vertebral apophysis.

Forty-fourth Case—History—Patient, aged 32, admitted to Harlem hospital Jan. 12th, 1891. This patient was a brakeman, working at night when the accident happened. He was about to step from one track to another when a car was backing in which had no signal light on struck him a violent blow on the back and side and knocked him down. He was unable to give a clear description of how he was injured, hence this rather indefinite statement was all we could get from him. He was able after a time to make his way to the freight office, when an ambulance was called and he was brought to the hospital. I saw him the next day. Now he had great pain at the dorso-lumbar junction of the spine. And over this site the tissues presented a fullness and were very sensitive to the touch. Paraplegic symptoms in the spine were clear. The right lower extremity was quite devoid of motion, though sensation was intact. The left side was affected to a less degree than the right. There were no serious constitutional symptoms, though his urine, which he was unable to void, was deeply blood-stained.

Diagnosis—Contusion of the spinal cord, rachidian hemorrhage, extra thecal, with moderate, consecutive meningitis.

He steadily improved and left the hospital after two weeks, at which time he could walk by the aid of a cane. He finally (as have nearly all those cases of this class which are not fatal) made a complete recovery and returned to the brake again.

Forty-fifth case—History—Patient, aged 43, admitted to the Harlem hospital July 25th, 1892. This man, while at work in a lumber yard on this date, was violently struck on the back by the end of a very heavy piece of falling lumber, which came from a considerable height. He was felled by the blow, and, on attempting to regain his feet, discovered that he had lost all power in them, that they were powerless. He almost immediately commenced to vomit and manifested other pronounced symptoms of profound shock. He was admitted to the hospital two hours after injury, when there was well-marked paralysis of the reflexes of the lower extremities, but sensation was not totally abolished. He now had the most agonizing pains in the back, besides incessant vomiting. There was already rectal and vesical incontinence. On examination of the spine a fracture of the posterior arch of the ninth dorsal vertebra was discovered. The fragment was quite movable.

Diagnosis—Fracture of the spine, with hemorrhage into the spinal canal.

Operation—July 26th—In considerable pain, but general condition better; now able to move feet slightly. In the afternoon of this day patient was prepared for operation, when without any difficulty, both posterior lateral arches, which had been fractured close to the pedicles, were raised, their ligamentous attachments, with them, were stripped away with the scissors, and the fragments were lifted out. There had been no displacement of them or pressure on the cord from them. When these broad osseous plaques of bone were lifted out and the underlying blood clot sponged away, the nude, white, glistening surface of the dura mater came into view, so that fully an inch of its posterior and lateral surfaces could be distinctly seen and felt with the finger through the opening in the large hiatus left by this removal of bone and ligament. The dura mater showed no traces of injury. Now the wound was drained, buried under a mass of fluffy dressings, when he was returned to bed.

July 27th. On this day, although his paralytic symptoms presented no evidence of abatement, his general condition was much worse. At 12 m. pulse 122, temperature 103 3-4.

July 28th. Now in terrible distress, demanding very heavy and oft-repeated doses of morphine to even partly relieve it. Respirations very rapid, wholly diaphragmatic, vomiting attended with great straining; temperature 104 4-5, pulse 150; face now deeply cyanotic; expectoration impossible; has the "girdle symptom; is commencing to be delirious. Shortly before noon the next day he died, after a most agonizing struggle, the mind seeming to be clear up to the last; for as the end approached he became calmer, asked to see his family and said he knew he was about to die.

Post Mortem Examination—Twenty-six hours after death, by special consent, we were permitted to open the spinal canal. It was found that, along with the fracture, there had been an enormous hemorrhage, entirely extra thecal, which had been caused by an extensive laceration of the meningo-rachidian plexus of vessels, in both sides of the cord, close to the seat of fracture. The blood was coagulated and filled the greater part of the canal above and below the seat of fracture. The evidence of incipient meningeal inflammation was seen, though, as yet, there was but slight plastic formation between the meninges.

Comments—This was one of the most agonizing cases I have ever seen. The only hypothesis on which the violent and ungovernable gastric

disturbances can be accounted for is that the solar ganglia of the sympathetic had shared in the injury. What share the exposure of the bare meninges had in the operative proceedings in forming a fatal termination, if any, I am unable to say; but my impression is that it decidedly militated against his prospects of recovery.

LESIONS IN THE LUMBAR AND LUMBO-SACRAL REGIONS OF THE SPINE
AND SPINAL CORD (THE CORDA EQUINA) OF A TRAUMATIC ORIGIN.

Traumatic lesions of the lumbar and sacral regions of the spine are the least common. The latter are very rare. Owing to the great depth of the spinal cord in the lumbar region, the great strength and volume of the osseous framework, with its numerous ligaments and voluminous muscle supports and protection, it is least exposed to indirect violence or to concussive force, applied either from above or below. Hence the only manner in which the spinal leath of nerves in this situation can sustain serious injury is by direct force, applied from behind. But wrenches of the muscles, tendons and ligaments here in "the small of the back," are very common. One will often complain after making a heavy lift in certain feats of agility, or after falls, of having "sprained a cord," or ruptured one, in the back. No doubt what does sometimes occur in these injuries is a real rupture or laceration of one or more fasciculi of the sacro-lumbalis, erector spinae or the latissimus dorsi muscle, after which there is leakage from a vessel and the formation of one or more haematomata. But lesions of the bones or *cords* in the lumbar region are quite impossible through concussive or percussive force without coincident damage to internal organs. The sacrum cannot sustain serious trauma from concussive force without the pelvic bones sharing in the effects. In Watson's 141 experiments on the spines of dogs in but two instances did he succeed in fracturing the lumbar vertebrae or effect a dislocation in this region; although there is almost no comparison in the strength of the one in the canine and the human species, because of the difference in function. It is well, then, in all cases of injuries to the spine, in which it is alleged that force was sustained in the lumbar region, to be assured of its quality, volume and direction, before we pronounce its effects as involving the central nerve elements. As this segment of the cord presides over no organs immediately vital to life, when seriously damaged by an injury it generally leads to death through the complications which it entails rather than by direct influence on vital centers. I have noticed that ascending meningitis is less frequent here than in the districts above. Hence when this region is injured, provided the disorganizing force is not too great, or involves the abdominal viscera, the chances of recovery are better here than elsewhere.

Forty-sixth Case—(Lumbar and Sacral Group)—History. Patient, aged 24, good physique, admitted to Ninety-ninth street hospital July 13th, 1883. This man, on the morning of entrance to hospital, was struck with great force while boarding cars, while in motion, in such a manner that he was severely injured in the lumbar region. He was in great shock when admitted to the hospital. He had paraplegia complete, no control over the bladder or rectum. He remained in about the same condition for two days. Over the seat of injury, besides a slight discoloration of the integument and

some tumefaction, there was no external signs of injury or anything to indicate external damage to the central parts. Urine was highly charged with clear, red blood, which dripped slowly but almost continuously from the urethra. Complains but little of pains in the back.

Diagnosis—Contusion of the corda-equina, spinal hemorrhage, laceration of the capsules of one or both kidneys.

July 14th. Now has priapism and is commencing to complain of the "girdle symptom." Temperature 102 degrees, pulse 122.

July 16th. Paralysis is extending upward, mind becoming dazed; is delirious at times.

July 17th. Marked change; respiration rapid; altogether from the midriff; temperature 105 degrees, pulse 148; sinking. Died at 11 p. m.

Post-mortem Examination—Twenty-four hours after death, on autopsy, a fracture of both the spinous processes of the last dorsal and first lumbar vertebrae was found. One fragment, the spinous process of the dorsal vertebrae, was so driven in as to almost cut the cord in two. Perimeningeal space was filled as far up as the second dorsal with a dense coagulum of blood. The superior segment of the cord was intensely hyperaemic. That part of the cord under the displaced fragment was crushed to a pulp, softened and saturated with blood. The arachnoid and pia were deeply congested and in places glued together with coagulable lymph. On opening the abdomen free hemorrhage into the pelves of both kidneys was found.

Comments—This was a typical case of mortal lesion, in which death promptly followed an injury. It was unusually rapid in its progress.

Forty-seventh Case—History—Patient, aged 41, derrickman, admitted to Ninety-ninth street hospital May 18th, 1884. Patient, while raising rock from an excavation, incautiously got in the way of a boulder, which had irregular angles, and before he saw it he was struck directly over the loin by a jutting end as it was making a circuit towards the truck on which it was to be laid. He was thrown forward on his face and hands. But he was able to rise unassisted. He, however, felt the shock of momentum through his entire frame, and had a sense of impending syncope. Now the ambulance was called and he was brought to the hospital. Shortly after his arrival he felt a numbness in his feet. By the next morning he was completely paraplegic. Urinary incontinence, urine withdrawn with catheter, very bloody from the first day, bowels constipated. He was put on low diet and the bowels closed by opiates.

May 20th. Patient's general condition good; no abnormal temperature; pulse 106; urine clearing of blood; is shifted frequently from side to side and from one end to the other, in the bed, to prevent bed-sores; occasional twitching of the muscles of the thighs and legs.

May 26th. Paralytic symptoms subsiding; gradual improvement in the limbs from day to day.

June 2d. Out of bed and able to stand by supporting himself with his hands on the edge of a table.

June 12th. Left the hospital so improved that he could walk by the aid of a cane.

Diagnosis—Hemorrhagic compression of the lumbar segment of the cord, with consecutive paraplegia.

Comments—There was scarcely a doubt but that there was a free hemorrhage into the canal in this instance. But the spinal canal is large

here and the cord is small. In my experience a hemorrhagic effusion is more promptly absorbed in the lumbar hollow than above it. Perhaps this may be partially explained by the fact that in a large sanguinous leakage here, as it does not embarrass the respiratory centers, and thereby interfere, indirectly, with the circulation, it is the more effectually disposed of by natural processes.

Forty-eighth Case—History—Patient, 21 years old, a female, admitted to Harlem hospital April 12th, 1887. Three months before patient came under my care she fell the whole length of a flight of stairs. Was unable to get home without being carried. The next day she was paraplegic. She remained in bed under medical care for two months, when the power of motion returned to the lower limbs. She says that for two weeks her urine had to be drawn with the catheter. At the end of two months, as the use of the limbs were partly restored, she was taken with a very severe lancinating pain in the back, near the sacrum. From day to day this became worse, when finally an abscess formed and burst, on the left side at the inner margin of the quadratus-lumborum. Later another opening appeared, near the spinous process of the fourth lumbar vertebra. She was sent to the hospital for the treatment of these lumbar sinuses. On admission she had a low grade of hectic fever; temperature 101 1-4 degrees, pulse 110; was much emaciated; no paraplegia. Has constant pain in the back. There are marked atrophic changes in the muscles of the lower extremities. The circulation in them is feeble and they are cool to the touch.

Diagnosis—In the beginning, traumatism of the spine, consisting of contusion of the cord, with bone injury. Present time, suffering from traumatic spinal caries and general debility, consequent on confinement to room so long.

After an operation for the caries of the vertebrae, which proved to be the fourth lumbar spinous process, she made rapid recovery.

Comments—This was the only case in which I have seen secondary disease of bone with abscess formation succeed to spinal injury. It is very probable that the young woman was of a strumous diathesis, and that the injury was but an exciting cause in the way of exciting suppuration within the bone elements.

Forty-ninth Case—History—Patient, a truckman, entered Harlem hospital May 28th, 1890. At about midday on this date patient, who was driving a truck loaded with gravel, was thrown off on his face, and both wheels passed over him as he lay face downward. When he was lifted up it was found that he could not move his legs. Was now brought to the hospital. On admission was suffering from shock. His urine was drawn off with a catheter and was found to contain blood. Says he has a numb feeling in both feet. Can move the toes and ankles slightly. No signs or injury over the parts which had been crossed by the wheels.

Diagnosis—Contusion of spinal cord, with probable spinal hemorrhage, injury of kidney.

His friends came for him the same night and took him home. Heard nothing from him for several months, when he came to the hospital to have a bruised hand dressed. Said he had been laid up for nearly three months. Was now in his usual health.

Comments—Very many cases of wheel crushes have come under my observation during the past ten years. One almost constant feature pecu-

liar to them, when the trunk has been rolled over, is that when the wheel or wheels pass over the anterior aspect of the body the ribs, lungs, or some of the abdominal viscera, suffer damage, while, when the wheel or wheels cross over any part of the back, the brunt of the force is first borne by the spinal structures.

Fiftieth Case—History—Patient, aged 42, a brakeman, injured Dec. 11th, 1891. On the evening of this date patient was on the top of a car which was being switched from one track to another preparatory to making up a train, when, through some oversight of the switchman, the car was run on the wrong track. This track was occupied by low, empty coal cars. As the car on which he stood came in contact with these the rebound was very great and he was thrown forward. He came down on his back, striking with great force against the end of one of the coal cars, when he rolled over and fell outside the track. An ambulance was now called and he was brought to the hospital. Patient in considerable shock on admission; pulse very feeble; temperature sub-normal. No fracture of any bones in the body discovered. No signs of contusion on the integument over the back; complains of no severe pains. He was completely paraplegic. He had incontinence of both sphincters. In the evening the bladder was catheterized. It was greatly distended with blood. On careful examination of the spine, on deep pressure, the spinous process of the second lumbar vertebra was found rather more movable than normal, and there was an unusual fullness on the left side continuous to it.

Diagnosis—Probable fracture of the second lumbar vertebra, spinal hemorrhage, paraplegia and internal injuries.

In the evening after admission had an excessive hemorrhage from the urethra. Blood came in such a steady stream that the house surgeon, perceiving that profound anaemia was setting in, feared he would bleed to death. The urethra was tamponed and he was given iced drinks freely, and ice was applied over the spine. Towards evening it ceased. His condition continued without much change until Dec. 20th. The most troublesome complication was bed-sores, which commenced to form the third day. On the 20th his friends took him home and I attended him there. Then he steadily sank, dying on Christmas day.

Post Mortem Examination—Permission was given only to open the lumbar region. The autopsy was made under difficulties, as many of the relatives bitterly opposed it and it had to be hurried. Any one who has ever opened the lumbar segment of the canal knows what an extremely difficult procedure it is under any circumstances, without damage to the cord, and particularly when done in haste. Everything down to the cord was found blood soaked. The canal was densely stuffed by a large coagulum. When this was removed the white, pearly outlines of the radiating roots of the corda-equina came into view. No fracture had been found. It was to be regretted here that we were refused permission to open the abdomen, as there undoubtedly was an extensive laceration of renal tissue and probably a free retro-peritoneal hemorrhage. There can be no doubt of the origin of this hemorrhage, as it was drawn freely away with the catheter from the bladder. It could scarcely be vesical without a complete rupture of that viscus. In this case of spinal injury mortal renal hemorrhage was very nearly being the direct and immediate cause of death.

Fifty-first Case—History—Feb. 12th, 1893, patient, aged 24, seen by me at his own home. Two days before, while on a vendor's wagon descending a sharp decline, he was run into from behind by a street car, which was approaching, heavily loaded, rapidly behind him. As there had been a slight snow storm the brakes failed to arrest the car's speed. He, with his wagon, was thrown outside the tracks with great force. He was lifted up in a helpless state. Supposing that he had been but rather badly bruised, he laid up and applied soothing balms over his back, which was very sore in the lumbar region. But he was alarmed, four days after injury, in discovering that he was quite unable to walk. Now I was sent for. At this time he had no fever and his general condition was good. Sensation was diminished in both lower extremities, and motion was feeble. The reflexes were normal on the right side, but on the left the patellar was much diminished.

Diagnosis—Contusion of spinal cord, slight.

I assured him that his spine was not badly injured. I saw him again in a week, when he was nearly well. A month later he was as well as usual.

LESIONS OF THE SACRAL SEGMENT OF THE SPINE.

Disorganizing lesions of a traumatic origin which involve the sacrum or the pelvic walls, posteriorly, I have seldom seen, except associated with fracture of other parts of the pelvis. It is here that the spinal cord splits up and finally becomes lost. Kicks and blows over the sacrum have been recorded as causes of rectal and vesical paralysis. But when this occurs it must be rather by damage to the nerve trunks than the central ganglia. A few of such have come under my observation. As the sacrum constitutes an essential part of the spinal canal, and as in few of our text-books there is any mention of sacral lesions, it was thought that in a review of this description, which includes the whole canal, this part should not be overlooked.

Fifty-second Case—History—Patient, aged 37, laborer, employed in excavating rock in cellar digging, admitted to Ninety-ninth street hospital July 20th, 1884. On the morning of this date patient, when adjusting fragments of blasted rock while they were being raise onto a truck, incautiously came in the way of a boulder, as in a preceding case, which was being raised and swung, and was struck a crushing blow from behind by its sharp, jutting projection, and was thrown to the ground, forward, by its force. The blow gave him so much shock that he was unable to walk after the accident, but he could stand with aid of support. The following day he came under my observation. At this time his general condition was good. He complained of severe pain, however, very low down in the back. The right leg was anaesthetic as far as the knee, and he was powerless to move his ankles or toes. The left leg he had perfect control over, but he said the heel and sole were "asleep." Over the sacrum, about an inch and a half below its articulation with the last lumbar vertebra, to the left side, there was a depression and discoloration of the skin. No fracture could be made out.

Diagnosis—Contusion of the sacral-plexus of nerves on each side.

Patient remained in hospital ten days, when he was discharged quite as well as ever, except for some weakness which remained in the right leg and thigh.

Fifty-third Case—History—Patient admitted to Ninety-ninth street hospital Sept, 5th, 1884, aged 27 years. Was injured by the premature explosion of a dynamite blast, in which two men were killed outright. When brought to the hospital was in deep shock. Patient had been struck across the nates by a flying piece of rock. The trousers were rent across the seat. There was a deep, transverse laceration over the sacrum, which opened widely to view the sacral apophyses and exposed several of the nerve roots which emerge through the sacral-foramina. The os-iliu had been fractured in an oblique direction from above downward.

Diagnosis—Fracture of the sacrum, hemorrhage into the spinal canal and internal hemorrhage.

As the man recovered from shock it was apparent that he had complete paraplegia. There was no rectal incontinence, but the bladder had to be drained with the catheter. The urine was highly charged with blood. During the night the patient showed signs of internal hemorrhage. The abdomen bloated up, vomiting set in, and he sank early the next morning.

Post Mortem Examination—Ten hours after death an autopsy was made. Opening first at the point which was crushed posteriorly several fragments of bone were found driven into the spinal canal, on the nerve roots, which were extensively torn and lacerated. The lower part of the spinal canal was stuffed with blood-clot. On opening the abdominal cavity it was found largely occupied by a blood-clot and sero-sanguinous fluid. The bladder had been ruptured and a free tear was discovered in the posterior wall of the iliac vein.

Fifty-third Case—History—Admitted to Ninety-ninth street hospital June 12th, 1885. Patient 41 years old. This man was a house finisher. On the day he was brought in he was at work suspending a fire-escape on the fourth story, when he slipped, in some way, and came toward the ground in a sitting attitude; for the force of the fall was mainly spent on the sacrum and coccyx. The coccyx was separated by diastasis from its attachment. The crest of the right ileum was fractured in a downward and backward direction, so that the line of separation extended into the sacro-iliac synchondrosis, which was partly loosened and movable to forcible pressure. Patient in shock on entrance to hospital. Complete paraplegia; incontinence of urine. The pelvis was placed in solid gypsum dressing; urine drawn off bloody. By distension of the bladder with boracic acid solution it was demonstrated that it was not ruptured. Came out of shock within two hours after reaching bed. There were no symptoms indicating brain or other internal injury, except the haematuria, which was transient. On the sixth day he commenced to use the lower limbs.

Diagnosis—Hemorrhage into spinal canal in sacral region, fracture of ileum, with partial diastasis of the sacro-iliac and sacro-coccygeal articulations, probable slight laceration of the kidney.

Comments—This man made an uneventful recovery and left the hospital on the twenty-second day after entrance, with fair restoration of strength and motion in the body and lower limbs.

Fifty-fourth Case—History—Patient brought into Harlem hospital May 2d, 1889. Patient's age, 16 years. Was playing on cars in freight yard,

jumping on and off, with other boys, as trains were being shifted. In some way he fell between two cars, was caught by the truck underneath, and had his pelvis and sacral spine terribly crushed by the accident. When put in an ambulance was in almost a dying state, it was thought, but after he was placed in bed and artificial heat applied he rallied. Now he was in such terrible pain that morphine had to be given in heavy doses to relieve it. He had sustained a crushing blow over the sacrum which partly displaced this bone from its articulations with both ilia, fractured the pubic bone through either ramus, besides broke the fourth, fifth and sixth ribs on right side. There was complete paraplegia.

Diagnosis—Multiple fracture of pelvis and ribs, double dislocation of sacrum, laceration of cord.

There was complete incontinence of faeces and urine. Bladder evidently ruptured. Patient died shortly after midnight. The body was removed home almost at once after death. No *post mortem* was made.

Fifty-fifth Case—History—Patient, aged 31, admitted to Harlem hospital Feb. 16th, 1890. This young man was riding on a freight train by stealth. As it approached the city he jumped off when the train was in rapid motion. It was just dawn in the morning so that he could not see well. As he struck the earth he came down on his buttocks and sacrum. After lying awhile by the roadside he got up and made his way home. All the time, he said, he suffered the most intense pain in the sacrum and coccyx. The following morning he had numbness and was unable to stand, owing to the want of power in his legs. Remained in bed ten days, when he was sent to the hospital. At this time there was no constitutional disturbance. He only complained of pain over the sacrum and was unable to walk without crutches. There was evident muscular atrophy in both lower extremities. Sensation, also, was notably diminished. He is greatly worried about the loss of power in his limbs and says if these were "all right" he would be well again.

Diagnosis—Contusion of sacral end of spinal cord, with extra thecal hemorrhage.

He was sent home and told to come to the hospital every second day for treatment. He slowly but perfectly recovered. In three months was able to return to his work as a carpenter.

Fifty-sixth Case—History—Patient, aged 32, a rockman, while at work, was struck from behind by a stone which had slipped from an embankment, and hit him over the sacrum while he was in a stooping position. Entered Harlem hospital May 2d, 1891. This stone had a sharp edge, for it cut the tissues through the trousers in an oblique direction over the median line of the sacrum. Was in great pain when admitted over the point of injury. Complained of nothing else when he entered. The next day was slightly paraplegic. Unable to flex the knees, but has some motion in the ankles and toes.

Diagnosis—Contusion of sacral segment of the spinal cord, consecutive extra-dual hemorrhage and paraplegic symptoms.

Paraplegia was marked on the fourth day. It on the fifth became less marked. He improved steadily and left the hospital after remaining three weeks. His recovery was complete and he returned to work after six weeks.

MISCELLANEOUS CASES OF TRAUMATISM OF THE SPINE AND SPINAL CORD AND CASES IN WHICH ALLEGED INJURY OF THE SPINE HAS BEEN MADE THE BASIS OF LITIGATION.

This series of cases will be concluded by including with a brief report of sixteen others, which present varying types of injury. Very many more might be added, but, as it is the intention in this report to include none but those in which the spinal cord was implicated, or its coverings, those of a purely extrinsic character will be purposely omitted.

Fifty-seventh Case—History—Patient, aged 45, admitted to Ninety-ninth street hospital May 7th, 1883. This man had been out riding with his wife on a Sunday afternoon, when his horse took fright, the vehicle was cap-sized, and he was thrown headlong to the surface of a macadamized road. Was brought in by an ambulance in an unconscious state; lay in coma until morning; now conscious; can move the head freely but has no power over the arms or lower limbs; urine drawn off by catheter. Patient remained in about the same condition, without any important change, for four days, when motion in the limbs gradually showed signs of returning. On the sixth able to move his arms.

Diagnosis—Contusion of the brain and spinal cord.

Brought home on the eighth day. Never heard anything further of the case.

Fifty-eighth Case—History—Patient, 24 years, admitted to Ninety-ninth street hospital Aug. 2d, 1883. This young man, while intoxicated, undertook to cross a railroad with an express train in sight. He had not quite crossed when he was struck by the locomotive and thrown into a heap near the track. Much to the surprise of his comrades he was able to get up without help. But his right leg had been hurt and he was sent to the hospital. Here nothing could be found but a sprained ankle, without fracture. The ankle commenced to swell and became very painful. But, the sixth day after admission, he complained of paralytic symptoms in the extremities, the most marked in the legs. This became quite pronounced by the end of the tenth day. In the meantime the ankle became very greatly swollen, and necrosis of the head of the tibia was suspected. On the twentieth day an abscess opened near the inner-malleolus. The same day the bone was cut down on and a quantity of necrosed osseous tissue was gouged away from the head of the tibia. Shortly after this paralysis commenced to disappear. Power was first re-established in the upper extremities.

Diagnosis—Violent sprain of the ankle joint, contusion of the spinal cord, consecutive osteo-myelitis, with moderate general paralysis.

He left the hospital quite recovered Sept. 27th, 1883.

Fifty-ninth Case—History—Patient, 28 years old, brought into Ninety-ninth street hospital March 12th, 1884. This man was on a truck loaded with lumber, crossing a bridge, when the horse became frightened by a train which was passing under. He was thrown off, forward, and crushed between the walls of the bridge and the wheels of the truck. His limbs were terribly mangled. Both femora were fractured. He was in great distress when he entered the hospital. He was given enough narcotic to relieve the intensity of the pain, and the shattered limbs were put into a comfortable adjustment. The following day both upper extremities were anaes-

thetic and motion was entirely lost in the right arm. March 15th paralysis in both upper extremities complete. As he had no pain in the fractured thighs, it was evident that the lower extremities were likewise paralyzed.

Diagnosis—Fracture of both femora, contusion of the spinal cord, consecutive palsy.

March 20th. It looked on this date as though recovery was possible. But there were two large bed-sores, which added greatly to the difficulties in treatment. Toward evening on this date his temperature suddenly went up to 105 1-4 degrees, when he became furiously delirious, dying two hours later.

Post mortem examination was refused.

Sixtieth Case—History—Patient, 9 years old, admitted to Ninety-ninth street hospital July 6th, 1884. This little fellow had been on an excursion up the Hudson river during the day. In the evening, while the deck hands were making the boat fast to the dock preparatory to discharging the excursionists, this boy got in their way, when his left leg was caught in a cable and he was suddenly dragged with great force through an opening on the side of the boat and crushed against a pile of boxes on the dock. When admitted to hospital the foot and ankle were badly disorganized, mangled and bleeding. The bleeding points were secured, the limb placed in a comfortable adjustment, and he was freely stimulated. The next day, well-marked paralysis of all the members. In the lower sensation was quite lost, but in the upper, though motion was lost, sensation was yet intact. No brain symptoms.

July 8th. Left foot undergoing dry mumification; line of demarktion formed on the sixth day four inches below the knee joint.

July 10th. Limb amputated in middle third of the leg.

July 12th. Symptoms of abatement of the paralysis all over the body.

Diagnosis—Compound comminuted fracture of the leg, contusion of the spinal cord, with consecutive paralysis.

This boy made an excellent recovery, leaving the hospital Aug 12th, 1884. It is supposed that when his foot became entangled with the rope and he was suddenly dragged round one of the gate posts, off the dock, the spinal column sustained a violent twist, with resulting laceration and compression of the cord.

Sixty-first Case—History—Patient, 42 years old, admitted to Ninety-ninth street hospital June 7th, 1886. Patient was driver of a circus van. On the previous evening, while entering the city with a caravan, driving six horses, they became startled by a display of fireworks and for a moment were quite unmanageable. In the *melee* he was thrown off his high box and, after falling, was trodden on by one of the horses. He was raised, placed on the stoop of a house near by, when an ambulance was called. On entrance to the hospital it was found that he had a dislocation of the right shoulder, with fracture of the left femur, in the lower third. Was in considerable shock. The next day he noticed, for the first time, a numbness in the extremities, with diminished power to move them. The bladder had to be emptied with the catheter. Urine highly tinged with blood. After the first week complete power had returned in the uninjured extremities, and the urine had cleared of any sanguinous staining.

Diagnosis—Dislocation of shoulder joint, fracture of femur, with violent commotion of the rachidian-viscera.

This man made an uninterrupted recovery, though when dismissed from the hospital, ten weeks after entrance, the strength, equally in both arms, was markedly diminished.

Sixty-second Case—History—Patient, a boy 14 years old, admitted into Ninety-ninth street hospital Aug. 14th, 1886. Two days previously the boy, while climbing a fruit tree, when up a considerable distance, fell to the ground through the breaking of a branch. He fell, it was said, about 20 feet, striking directly on a rock, the surface of which projected through the ground. He was first taken home. Here the family physician who treated him discovered a fracture of three ribs and a fracture at the elbow, right side. On the third day it was noticed that he had no power to move his legs, and as they, with the arms, were equally devoid of feeling, he was sent to the hospital. On admission the ribs, third, fourth and fifth, close to their spinal articulations, were found fractured, with a fracture and slight luxation at the right elbow joint; besides distinct, though not complete, paralysis of the extremities. He was unable to urinate; urine voided with catheter for three days after admission.

Diagnosis—Costal-fracture, elbow-joint fracture and dislocation, contusion of spinal cord, consecutive palsy, partial.

This lad made a remarkably rapid and complete recovery, leaving the hospital with full restoration of function on the thirty-second day after entrance.

Sixty-third Case—History—Patient, a young man 23 years old, a negro, admitted to Harlem hospital Feb. 9th, 1887. Patient was an hostler and jockey on the Westchester race course. The day before admission patient, while exercising a powerful young gelding, and running him at the top of his speed, was thrown by him, striking with great force on the ground. He was picked up in an unconscious state. Two hours later consciousness returned. Now it was found that he had fractured the clavicle on the right side and had dislocated the left shoulder. When admitted to the hospital shoulder yet unreduced. He had now moderate paresis of the lower extremities, with urinary incontinence. Slight tinge of blood, with the urine. No paralysis in the arms, but abdominal surface quite anaesthetic.

Diagnosis—Fracture of clavicle and dislocation of opposite shoulder, moderate paraplegia from contusion of the spine.

Like the preceding case recovery was rapid, and he left the hospital quite recovered after a five weeks' sojourn.

Sixty-fourth Case—History—Patient, 26 years old, admitted to Harlem hospital June 12th, 1887. Patient was a young woman who, on the morning of this date, while sitting on the sill of a window on the fourth story, washing the glass, in some manner lost her balance and fell into the stone-flagged area below, a distance of about 38 feet. When brought into the hospital was in a state of shock. Had fracture of the lower jaw the left humerus and through the crest of the right ilium. Recovered from shock after a few hours. The following day had retention of the urine and complained of a sense of numbness in the hands and feet, besides had very severe pain over the entire spine. Expecterated blood freely through the day. This anaesthetic condition of the extremities continued through the following ten days, but after a week she had control of the bladder.

Diagnosis—Multiple fracture, violent contusion of the spine, with subsequent congestion of the spinal cord.

This young woman, whose anatomy had been so shaken and shattered, finally made a very good recovery, though she was in the hospital nearly six months before she was discharged. She married the following month after leaving.

Sixty-fifth Case—History—Patient entered the Harlem hospital Oct. 17th, 1887, aged 34. This man was injured by a runaway accident. He was thrown with great violence against the curbstone of a sidewalk, as the front wheels of the vehicle collided with a lamp post. When admitted to hospital was in a dazed condition. Had a compound fracture of the right fibula and tibia of the right leg, with an extensive scalp wound. No cranial fracture could be discovered.

Oct. 18th. Complains of severe headache, pains in the arms, with numbness and diminished power in the lower extremities. Continued in about the same condition for four days, when symptoms of improvement were evident.

Diagnosis—Contusion of brain and spine, consecutive spinal irritation, compound fracture of right tibia and fibula.

Oct. 24th. Removed home by friends. He ultimately made a good recovery, but suffered from weakness of the muscles of both lower extremities for some months after the fracture had perfectly united.

Sixty-sixth Case—History—Patient admitted to Harlem hospital June 12th, 1888, a boatman, was injured by the iron scoop of a coal-lifter, which struck him, while loaded, over the right side and back and crushed him against the walls of the boat. When he entered hospital had fracture of the third, fourth, fifth and sixth ribs, close to their spinous attachments. Complained of great pain in the back. Had moderate haemoptysis, with severe dyspnoea. The following day he had anaesthesia over the abdomen and said that his feet and legs were the seat of a sensation as if "asleep." The motor power in the right limb well diminished. Mobility unaffected in the left lower limb. Upper extremities not affected.

Diagnosis—Costal fracture, contusion of the spine.

The symptoms of incipient paralysis, with spinal lesion, passed away after the sixth day. He left the hospital on the 30th of July, quite restored for one so violently crushed. He promised to report later, but failed to do so.

Sixty-seventh Case—History—Patient admitted to Harlem hospital June 16th, 1889, aged 12 years. This boy had climbed on to a staging and fell to the ground, a distance of 28 feet, pulling a heavy plank after him. Had a dislocated right shoulder, with fracture of shaft of radius on left side. After dressings were applied he was brought home and attended by family physician. Two months after admission reported in out-patient department, at this time coming to be treated for paresis of both extremities. The mother stated that ten days after he was brought home he quite lost the use of his lower extremities, but that with the aid of massage, electricity, etc., he recovered sufficiently to be able to walk with the use of a crutch and stick.

Diagnosis—Shoulder dislocation, with fracture of radius on opposite side, contusion of spinal cord.

After coming to out-department for electrical and tonic treatment for about two months he made a good recovery.

Sixty-eighth Case—History—Patient, aged 4 years, injured Jan. 2d, 1890. Was called to see the case in consultation with Dr. W. T. McManis, of this city. The little one was injured by falling off a fire-escape into the yard below, a distance of about 45 feet, from the fourth story. In his transit to the surface he came in contact with the clothes line, which was broken. He struck on the stone surface of the yard and was picked up in an unconscious condition. On examination it was found that he had fractured the right femur and had produced a compound depressed fracture of the skull on the left side of the median line at temporo-parietal junction. The skull was trephined and dressed and the fracture of the thigh adjusted. The following day he had recovered from coma. He made an excellent recovery from the brain and femoral injury, but after the fifth week he developed paraplegic symptoms. For two weeks had little or no sensation in the feet. The uninjured limb was equally as helpless as the fractured one.

Diagnosis—Fracture of right femur, fracture of the skull and contusion of the spinal cord.

The paraplegic symptoms were of short duration and quite disappeared within three weeks after he was placed in the sitting posture.

Sixty-ninth Case—History—Patient, aged 41, admitted to the Harlem hospital June 16th, 1891. Patient was a janitress, who was injured by having been caught and crushed by a falling dumb waiter, which struck her with great force over the back of the head, tearing widely open the scalp, severely contusing and spraining the neck. Scalp wound dressed and patient sent home in conveyance brought by friends. She did not report again, as she was treated by her family physician at home, until six weeks later, when she came in again for treatment of partial paralysis of both arms.

Diagnosis—Lacerated wound of scalp, with severe contusion of the neck, with injury of the brachial plexus on each side, and injury to spinal cord.

She came in for electrical treatment, massage, etc., twice a week for nearly two months. She ultimately made a good recovery.

Seventieth Case—History—Patient admitted to Harlem hospital Aug. 12th, 1892, male, 24 years old. Was injured by being crushed while coupling cars. When brought to the hospital had an extensive fracture in an oblique direction through the crest of the right ilium. He was in deep shock. The following morning had rallied, but now complained of severe pains over the entire back. Towards the beginning of the fourth week commenced to complain of a burning sensation in both feet and a numbness in one hand. Finally, after a few days, there were distinct areas of anaesthesia in both lower extremities. This phenomena was of but transient duration and passed off after ten days.

Diagnosis—Pelvic fracture, contusion of the spinal cord.

This man made a good recovery in a general way, but for some time after he took the crutches, he complained of a sense of numbness at times in the soles of the feet.

Seventy-first Case—History—Patient, aged 48, was injured Feb. 12th, 1893. She was a heavy, stout woman who, on the morning of this date, slipped on the icy steps of a high door stoop and fell with force to the bottom. She was taken home in an ambulance, when the first physician

who was called declined to treat the case. It was turned over to me. I found that she had a fractured femur on right side and presented symptoms of brain injury. On the fourth day after the accident the cerebral symptoms improved. Now she complained of severe pain in the back. On the beginning of the third week complained of weakness and want of sensation in both arms. In the left the grip was very feeble. Though better on the right, yet much below the normal in power. The muscles in the neck were affected with spasm, so that the head could not be turned without moving the upper trunk.

Diagnosis—Fractured femur, contusion of brain and spinal cord.

Now, April 17th, 1893, these neural symptoms have mostly disappeared, and she gives promise of making a good recovery, with the exception of a defective limb after the fracture.

PART II.

EXPERIMENTAL CONCUSSION, TORTION, COMPRESSION AND PUNCTURE OF THE SPINES OF CATS AND DOGS.

By an analytical study of the results obtained in Watson's experiments much light is thrown on this whole subject of concussive force. And while we shall see that but few of the animals sustained serious or mortal lesion of the spinal cord, yet some of these animals were instantly killed—six out of 141, or 4.26 per cent. Sixty-seven suffered serious internal organic injuries of the lung, liver, kidney, the vascular organs and bladder, or 42 per cent. Many sustained fractures, dislocation and diastases of the bone shafts and joints. Out of the entire number the experimenter was not able to affect any paralysis, or so injure the spine that on *post mortem* examination lesions could be discovered in but 15, or 10 per cent. And of these it was clearly evident that those punctate hemorrhages into the pia, which were present in eight of them, would in a short time have disappeared and the animals recovered; so that it may be said that only seven, or 4.95 per cent, sustained any injury of the cord which would have caused a permanent crippling or led to an ascending meningeal inflammation with consecutive degenerative changes in the spinal cord's parenchyma. But, if the cord escaped, the shock of concussion, in all except a very few of these cases, the other more exposed and dependent organs and parts suffered serious damage in several cases. While in all the excentric parts, as the muscles, bones, peripheral nerves and vessels, suffered in varying degrees. This series of experiments of Watson's, combined with my own, are abundantly extensive to clearly, definitely and indisputably demonstrate:

First—That the degree of concussive force necessary to induce *centric* lesions of the spine, i. e., of the meninges and medullary substance, must always be very great.

Second—That disorganization of the cord from concussive shock in such a degree as to manifest itself by neural symptoms can seldom exist without an association of other visceral or structural injury—fracture, diastasis or dislocation of the vertebrae.

Third—That spinal hemorrhage, when present in sufficient volume to compress the cord, is always consecutive to injury of the vertebrae, muscles, tendons, ligaments or joints, and that such hemorrhage is nearly always seated outside the medulla-spinalis; is extra-theal or extra-medullary.

Fourth—Concussive violence may be immediately mortal in its consequences—may totally destroy an organ, cause fracture or dislocation, disorganizing contusion or laceration, without in any manner seriously disturbing the neural elements within the theca vertebralis.

Fifth—These diverse sequelae of bodily violence deliberately inflicted on the lower animals all have their counterparts in those traumatic lesions, the result of accidental injury, so commonly witnessed in man.

Sixth—These series of experiments on the effects of concussive and other force practically embody what must be hereafter regarded as a principle of applied physics, which is, in concussive traumatisms of the human body, an immutable law, viz.: That distinct and serious lesions of the spinal cord resulting from concussive force without simultaneous and tangible implication of the internal organs or adjacent structures are rarely possible.

Seventh—In the majority of cases it was observed that the clinical symptoms were in strict proportion with pathological changes.

With the exception of those animals killed outright at the time traumatized, none died of their injuries which were not deliberately killed. The value of our experiments might have been enhanced had the animals been carefully nursed, placed under good hygienic surroundings and permitted to live until they had wholly recovered or died from such pathological conditions as would occur consecutively to traumatism.

It has been deemed advisable to make this short review of Dr. Watson's experimental work on the effects of concussive violence on the bodies of animals, inasmuch as neither Dr. Watson himself, or any other writer, in criticizing it, laid special emphasis on the salient features of it which so much concern the surgeon, viz.: That the experiments dealt only with one phase of physical force, the *concussive* or *indirect*, and though the end sought for and intended to accomplish—traumatic lesion of the cord—occurred in but about 10.6 per cent of those animals traumatized. The number of cord lesions being so small and so associated with other extensive disorganization of organs vital to life, they must rather be regarded as coincidences than independent serious factors *per se*.

AN EXPERIMENTAL INVESTIGATION OF ARTIFICIAL-TRAUMATISM PRODUCED ON TWELVE CATS AND TEN DOGS BY DIRECT VIOLENCE.

The difficulties which beset Dr. Watson's experiments on the effects following concussive or indirect force have been experienced by myself in an experimental investigation of this species on living animals, insti-

stuted for the purpose of artificially producing lesions of the spinal cord by *direct* force, local violent contusion and puncture by tortion, extension and compression. The cat, I soon learned, had the traditional "seven lives," and that its spinal region possessed a most marvellous density, flexibility and strength, which, for its capacity and proportion, far exceeded that of the dog or man. These experiments were commenced in December, 1891, the primary purpose being to determine the precise origin of intra-vertebral hemorrhage after spinal injury, and to note the effects of hemorrhagic pressure. In these experiments my observations on the effects of spinal injury were more exact than it would be possible to make them in those in which concussion is applied to the entire body, inasmuch as it was possible to observe the precise results following regional injuries without the association of encephalic complications. My preference for the feline species was because of their abundance in this city, where, to a large extent, they are considered as a pest and are easily secured. For spinal experimentation I have found them to fulfill my purpose as well as the dog, which, with us, is comparatively scarce, owing to the rigor of the license law, with the bounty on the head of the waif and unclaimed. But the cat is less domestic than the dog, and with his wonderful tenacity to life, combined with that inherent instinct of danger, after once traumatised, unless vigilently watched, will make away out of sight into holes and corners on the fore legs, when, on discovery by the police may, perhaps, involve the experimenter in a troublesome and expensive suit.

REGIONAL DIVISION, DIVERSITY OF FORCE, CHARACTER OF LESIONS;
CENTRIC AND ECCENTRIC.

My intention was to confine my observations to induced lesions in the lumbar, dorsal and cervical segments of the spine only.

First Experiment. The objective aim at the beginning was to determine the effect on the cord of violent bending. The pressing of the haunches was on the dorsum; then powerful lateral pressure was applied in such a manner as to avoid, if possible, injury to the abdominal viscera. With this purpose in view I had a bench so adjusted as to fix the hips and pelvis immovably, and then, with the animal fully under ether, the trunk as a whole, used as a lever, was seized and suddenly bent over at a sharp angle backward. First Experiment—Simultaneously with this motion there was a distinct tearing sensation under my fingers, at the lumbo-sacral junction, with a feeble, though distinct, audible crunching sound. Believing that a dislocation had been effected and that the cord was crushed through, the cat was laid aside. Now I noticed that it had incontinence of the urine and faeces, which, it was supposed, was due to injury of the spinal centers in the lumbar segment. The animal was laid in a large box with a straw bottom. Coming out of the ether he was groggy, and, in attempting to raise, toppled over. As he finally came to he raised himself on his fore legs. His hind legs he was powerless to stand on, though it was seen that he could slightly move one, the left. On passing a pin through the skin of the sacral and gluteal region he pulled himself away as if conscious of pain.

Diagnosis—Incomplete paraplegia.

As power of motion was lost, nearly completely, though some sensation remained, yet it was assumed that there was medullary disorganization, for we often find in man, in serious injuries of the cord, many of which are demonstrated *post mortem*, that sensation will persist for a time after all motion is lost, though in grave cases by the second day this, too, is quite extinct. The following day, to our surprise, puss was on all fours, though his gait was stiff and slow. But over the whole body he was as sore as a boil and immediately over the loin there was a marked inflammatory fullness on either side. It was evident then that the cord had wholly escaped any serious injury. Was killed.

Post Mortem Pathology—Cellulitis, myelitis, and arthritis, rupture of the fibrillae of the muscle with interstitial hemorrhage, laceration of ligament and aponeurosis with consecutive inflammation, extrinsic injury of spine somewhat analogous to severe sprain in the back in man.

Second Experiment—Female. From our experience with the first cat and the manner in which she escaped injury to the cord it was evident that here we must either add aggravated force or a combination of motions. Therefore, the animal prepared, the lumbar segment was placed directly across the bar of a carpenter's horse, when one seized the forelegs and the other the hind. The one holding the fore paws with the right hand while with the left, the dorsal segment was steadied and protected. Now, a sudden downward motion was made simultaneously by both, when the same phenomena as with the preceding were observed, but the movement was made in opposite direction with such force it would seem as would dismember the whole lumbar region. A strain equal to more than three hundred pounds had been applied on each segment of the spine for more than a minute. Now the animal was laid on its side when blood oozed through the mouth, and the eyes protruded from their sockets. Respirations were quick and jerky, and there was a fibrillary twitching of the brachial muscles. There was no doubt here that positive shock was induced and the cord had been compromised. The animal came out of the ether slowly. Total loss of power in hind legs followed, and on pricking gave no evidence of sensation. Incontinence as in the other. Animal made no effort to move forelegs. It was laid aside. The following morning on inspection, to my amazement, the cat was found standing on all its limbs, but it was weak, would not drink and was evidently in pain. It, however, rapidly improved.

Diagnosis—Extrinsic traumatism of the spine, laceration of muscle, ligament and aponeurosis, diffused inflammation, possible fracture of spine.

As I was particularly anxious to determine here under the naked eye just what the morbid anatomy was, on the fifth day after injury the animal was killed.

Post Mortem Examination and Pathology—Making first a long incision from the mid-dorsal region down to the sacrum, as the integument was divided between the superficial and lumbar fascia in the loose cellular membrane was a broad, thick remnant of an effusion of blood which was of a pale pink color and a soft friable consistence. Everywhere in the intermuscular spaces there was a matting of everything together by a plastic inflammatory exudate now undergoing fibrous changes. Within the erector spinae on the right side there was an effusion of blood which never had coagulated and by its black stain had imparted a dark tinge to the muscle fibre in its immediate vicinity. Above and below this were the free ends

of several ruptured and retracted muscle fasciculi. Detaching all the muscular tissues over the lumbar bodies, the vertebral column was reached. It was now clearly evident that there had been a giving way of the ligaments between the fourth and fifth lumbar vertebrae. The articular surfaces of the bodies gave an excess of lateral motion on pressure, though there was no distinct luxation.

Examination of the Cord—As the spinal canal was opened and the dura mater came into view no hemorrhage was seen in the exposed district, either under the membrane or into the cord. On its division, however, it was clearly evident from the turgescence of the arachnoid vessels that there had been an active congestion, but pathological changes did not advance to inflammation, as there was no trace of meningeal engorgement, no plastic foci in the subarachnoid fluid. The cord was normal in color and consistence.

Resume—Spinal injury, *eccentric*, muscular, ligamentous and arthritic laceration with vertebral displacement on motion, hemorrhage and consecutive congestion undergoing reparative changes.

Anyone who has performed much experimental work in the lower animals knows that there is almost no comparison either in tolerance or recuperative energy, with him and man. Hence why in the one we will observe recuperative changes as advanced in the lower animals in days as we will see in man in weeks and months. The condition which this animal suffered from was quite identical with that which may occur in man, which is designated as "spinal injury," that may be very tedious in recovering from, which is quite certain to leave more or less stiffness and weakness for varying periods, but in which the spinal cord itself has quite escaped.

Third Experiment—A large male cat was secured. Realizing now that nothing short of very considerable violence would make its impression on the spinal cord on this occasion, the animal was fixed under ether, the pelvis was immobilized, while the trunk was free. It was my purpose if possible to extent the injury to the cord without seriously involving any organ. In the two former experiments, though the cavities were not opened, it is probable that no important organ was badly injured. The animal being fully anaesthetised and adjusted, when a broad, thick muslin band was passed around and secured under the axillae by an assistant, while with my own hand firmly clinching the lower dorsal region a sudden and violent strain was thrown on the lumbar segment which would equal six hundred pounds tension. Under this the bones could be felt to snap around the entire circumference of the second and third lumbar vertebrae. To be quite certain that the trauma was radical and central in effect a similar motion in an opposite direction was executed and in addition a forcible rotatory twist was made. Indeed, after our manipulations were completed, which occupied about two minutes, the bones at this site seemed quite unhinged and a flail-like motion succeeded the former limited range of action. Animal profoundly collapsed and was slow in regaining consciousness. For the first hour it looked as if he would not rally, but in an hour and a half after trauma had been inflicted he commenced to move the fore legs and raise them. Lower extremities thoroughly paralyzed. Animal now returned to quarters. Following day entirely recovered from systematic disturbance and moved around lively, dragging itself on its belly and its fore paws as its posterior extremities were wholly powerless.

Took food well for the next four days when, as it was evident that the trauma was only local in effect, and, as there was no spread upward, the animal was killed.

Post Mortem Examination—Morbidity anatomy and pathological changes.

Free hemorrhage within all the tissues beneath the skin downward, now undergoing organization and resorption, extensive laceration of muscle, ligament, tendon and articulation. On reaching the lumbar apophyses the posterior arch of the fourth lumbar vertebra was found fractured on both sides close with the transverse processes. There was but very slight displacement of the fragments. In raising the fragments and displacing the broken bone a large accumulation of blood clot was found which, however, did not extend far in either direction. On removing this clot and cutting away two vertebral arches above and two below we came on the dura mater. On splitting this open, the unabsorbed elements of an effusion of blood in the subarachnoid space was found. This was of small volume. There was a plastic formation which glued the meninges together. The medullary substance immediately under the fracture was of a pulpy consistence undergoing red softening.

On opening the abdomen a large retro peritoneal effusion of blood had spread upward on one side marked by displacing the kidney, and on the other was traced into the lacerated capsule, from which it had evidently originated. In this case there were then:

First—Extensive eccentric lesions.

Second—Fracture.

Third—*Intra* and *extra* dural hemorrhage.

Fourth—A localized meningitis and a haemato myelitis.

Its analogue in man would be a case in which the trunk were caught and fixed, while the lower extremities and pelvis are violently rotated. The difference, clinically, consisted in the limitation of inflammatory and pathological changes in the lower animal, while with the human spine so injured the tendency is to a fatal advance upward of consecutive meningitis.

THE EFFECTS OF TORTION, ABDUCTION, ADDUCTION, EXTENSION AND COMPRESSION IN THE CERVICAL SEGMENT OF THE SPINE.

My next efforts were directed towards the neck, that part of the spine the most movable, exposed and vital. My principle object here was to determine if by varied and violent movements the spinal cord might be badly disorganized without the implication of the outer lying structures, and further to see if an artificial haemato-myelia might be caused by physical influences without the co-association of hemorrhage into the spinal canal outside the dura. This I have diligently watched, for in all my cases of spinal traumatism, experimental and clinical, as it has been alleged by some neurologists of late years since "railroad spine" came into vogue, "that spinal myelitis is in many cases consecutive and attributable to a haemato-myelia induced by a hurt, in which all the other elements of the spine escape." It goes without saying that it is a matter of vital importance that this allegation be supported or refuted, as it constitutes the key-stone to the arch, as it were, in the majority of litigant cases.

Fourth Experiment—Medium-sized male cat. Etherized, with body fixed at the shoulders. Two hundred pounds weight extension at the head, applied in such a manner as not to compress the tracheae. The animal was, after about five seconds' strain on the neck, released, the shoulders and chest yet fixed, when its position was so changed that sudden, steady force might be applied so as to crowd the head downward toward the thorax. Animal again released and laid aside. Two days later he had wholly recovered and was as sprightly as ever. Now he was again prepared for the application of force of a different quality. He was again fixed at the head, when a compound abrupt movement was applied, using the whole body for a lever and momental force, the intention being to suddenly propel the body against the neck and head. But we soon discovered that there is little analogy in these feline parts and those of man. The cat's cervical spine is nearly as flexible, serpentine and as elastic as a rubber coil. Hence it was only when imparting a slight but steady rotary movement we were assured that the spinal column was involved or the cord was exposed to damage. After several twists, combined with great pressure, the parts were again freed. Now the animal was deeply collapsed, breathed in gasps, foamed at the mouth and remained motionless for some time after the etherization passed away. Thinking that the animal had sustained mortal injury it was laid aside, well protected against cold. Late in the evening it recovered motion in the limbs, and in the morning walked, though with an unsteady movement which was most marked in the forelimbs.

Diagnosis—Eccentric injuries of cervical spine.

Three days later, when it was eating well and rapidly recovering his full strength, he was killed.

Post mortem, morbid anatomy and pathological changes. The cervical spine in a dog or cat is opened with great difficulty, as the neck with them derives its greatest strength rather from the overlying tough, thick integument, tendon, muscle, ligament and fascia than the deeply buried, delicate, tubular bone canal in which the cord is lodged. The neck was very greatly thickened and infiltrated. On dividing the skin a sero-sanguinolent fluid in considerable quantity issued through the incision. Beneath the cervical fascia extensive laceration of muscle substance with extravasated blood, which spread far into the adjacent parts, was apparent. By a very tedious and difficult dissection the vertebral rings were reached. There was no fracture and no vascular leakage into the spinal canal, the theca or cord. These symptoms which so strongly pointed to injury of the central organs of innervation were attributable to the peripheral nerves which necessarily were more or less stretched and contused in our manipulations.

We can conceive of no injury of the neck in the human being in which the same quality of force is applied. The nearest approach to it is with those in which the neck is violently wrenched and strained by falls, or in that class in which there is violent compression in consequence of the head being caught under a bridge, frame, etc. With the class of minor cervical spinal injuries the cord entirely escapes.

Fifth Experiment—In this venture my aim was to carry the fracturing disintegrating force down to the bony segments if possible and damage the cord substance with its meninges. To accomplish this, however, without actually decapitating the animal by the necessary vulnerant force was the difficulty. It would be a simple matter to dislocate and crush the cord

at the atlas-axoid joint, but that was foreign to our purpose. Female cat. Head fixed and body suddenly stretched, rotated and compressed. The neck was twice forcibly twisted and compressed with great energy simultaneously in each direction. In the last, which was the most powerful motion, something was felt to give low down near the fourth cervical. The animal was now laid aside, and for a moment or two ceased to breathe altogether. By artificial respiration in a short time, perhaps three minutes, the chest was seen to heave at irregular intervals. The lower jaw was widely opened, the tongue protruded at one side and the eyes bulged out of their sockets. The animal regained consciousness slowly. The next morning he was found completely palsied over the entire trunk. It lay on its side rapidly breathing in shallow gasps. These were irregular spasms in the cervical muscles of the left side of the neck. The conjunctivae were injected, the pupils widely dilated and the eyeballs on both sides drawn into a state of double convergent squint.

Diagnosis—Probable fracture and depression of bone, spinal hemorrhage, intra and extra dural, with medullary disorganization at seat of injury, consecutive meningitis of upper segment of cord and basilar membranes of the brain, central and eccentric lesions.

The animal died the same night in a mixed state of convulsive seizure and asphyxia.

Post Mortem Examination—Morbidity anatomy, pathological changes. At the seat of injury there was so much dissundering of the ligamentous stays that there was a free flail-like motion at the mid-cervical region. On division of the skin over the spinous processes blood issued through the tissues in every direction and was present in such quantities as to deeply stain the tendons, ligaments and aponeurosis, a deep purple hue. Ligament and muscle were extensively torn and the two posterior arches of the third and fourth cervical vertebrae were fractured and displaced inward on the cord. The extra dural space as far up as the occiput, was stuffed with a blood clot. The dura which was blood-stained was ruptured in a transverse direction and gave passage to a quantity of medullary substance. On dividing it upward it was evident that the large vessels in the arachnoid and pia had ruptured and emitted a large escape of blood which had extended upward into the base of the brain. The arachnoid in places was adherent by a plastic exudate which took an upward direction. The cord above the injury was reduced to a soft grumous mass. There was no luxation of the bodies of the vertebrae. Fracture, pressure, hemorrhage, with consecutive spino-cerebral meningo-myelitis were the immediate causes of death. In this experiment the force employed induced precisely the same physical phenomena as we encounter in very severe traumatic lesions, clinically, in the cervical region of man, viz.: first, pressure, next hemorrhage and lastly inflammatory changes. Death promptly followed here, because of the extent of violence and completeness of local destruction. This segment of the spine is its most vascular, both on the meningeal districts, the peridural space, and in the tissues external to the vertebrae. The arrangement of the dura mater by its external attachment to the foramen magnum prevented extra dural hemorrhage from entering the base of the brain, but as there is a direct communication between the vessels of the arachnoid and pia, with those of the membranes inside the encephalon, blood extravasates readily in either direction from the brain to the cord or *visa versa* in the event of leakage from those vessels.

Sixth Experiment—Middle-aged female cat. In this experiment the object sought for was to determine as nearly as possible the effects resulting from sudden jerks and commotions applied to the cervical spine, while the body was in a state of inertia. Accordingly, when the body was solidly fixed at the shoulders and the animal well under ether the head was seized and suddenly, with considerable force, first pushed to one side then to the other. Then the neck was crowded into the thorax with considerable force, at the same time imparting a rotatory motion to it. Under motion a crunching sensation was felt beneath the fingers and the hold was released. There was evidently fracture, though lower down than in the preceding case. Great shock followed, hemorrhage from the nose and mouth, irregular breathing. As consciousness was regained the head was slightly raised and lowered in spasmodic jerks. But the paralysis of the trunk and extremities was complete. Animal laid in a litter. The following day the fore paws were moved more or less on both sides. On the second day the animal had quite regained the full use of the fore legs, but when raised up and made to rest on them would fall over on its side. On the third day had relapsed again. All power of movement was lost and intermittent seizures were noticed particularly in the muscles of the eyes, neck and scapulae. In the same condition next morning, when she was killed.

Diagnosis—Fracture, hemorrhage (not haemato-myelia), consecutive spinal and basilar meningitis.

Post Mortem Examination—Morbidity anatomy and pathological changes.

Free fall movement at the seat of injury, copious hemorrhage into the loose muscular and cellular tissues, external to the vertebrae, etc. The general condition found was the same as in the preceding, except that the hemorrhage was altogether extra thecal and the cord, though everywhere deeply congested, was nowhere crushed through. The lesions inflicted on the central organs were:

First—Fracture of their overlying osseous rings, with extensive peridural hemorrhage.

Second—Consecutive inflammation of the spinal meninges.

Third—An extension of inflammation over the oblong medulla into the cranial meninges, with secondary cardiac and respiratory inhibition.

SECOND DIVISION OF FIRST SERIES.—INTERRUPTED CONTUSIVE PRESSURE OF SPINE AND CORD.

It may be noted in the foregoing experiments that the effects of angular flexion or rotation was not undertaken on the thoracic spine. As a matter of fact, traumatically, owing to the manner in which the costal wings of thoracic cage brace the spine on either side, it is quite impossible by this species of force to dissunder the vertebrae without fracturing the ribs and doing serious damage to the enclosed viscera. Hence the sort of physical force which most commonly damages the thoracic spine is direct, powerful, localized concussions, as by blows on the back, delivered with great energy, or falls, in which the body dropping from a height, strikes on some solid substance of such shape as to scatter the force over a limited segment of the spine. In this series, although the thoracic segment which, next to the sacral, is the most fixed of the spine, was

traumatized in a certain way for a definite purpose, yet the lumbar and cervical segments were also similarly treated. With this series of six cases the lumbar, dorsal and cervical districts were each successively traumatized after the manner indicated, two animals used for each. And, it may be added, that in all the force was applied by the way of violent, repeated blows, the concentration of force being spent on a limited area. Nothing was undertaken in the way of precipitating animals from a height, as Watson's experiments abundantly demonstrate that it is quite impossible to traumatize the spine by such falls with any degree of precision.

Seventh Experiment—Middle-sized male cat. Hind legs seized and fixed, while the head and paws were firmly held with the hands. Now, with a bar of iron weighing ten pounds, three feet long, the etherized animal was struck with great force over the lumbar region of the back. This was repeated five times. The animal was now laid aside, when, as it came out of the ether, it was noticed that the cord had escaped entirely, as he had full use of the limbs. The next morning he walked with difficulty, and over the seat of injury there was much tumefaction, which extended considerable distance upward over the dorsal region on both sides. On the third day this was beginning to subside, when he was killed.

Diagnosis—Eccentric injury, spinal haematoma, consecutive resorptive inflammation.

Post Mortem Examination—Morbid anatomy and pathology, free hemorrhage under the lumbar fascia, through the fasciculi of the erector-spinae and sacro-lumbalis, congestion, thickening of and effusion into the cellular tissue, the vertebral column and spinal cord not involved. This animal's injuries were wholly external to the rachidian structures. There was simply contusion, or mere "sprain of the back." It was now evident that to injure seriously the lumbar spine and cord by concussive force considerable violence must be employed. Indeed, as we may note, that, as the cord is very deeply buried here by an immense mass of muscle within the most powerful confines of the back, to produce a serious traumatism of it might be a very difficult matter without other mortal complications.

Eighth Experiment—Large male cat, secured as the preceding and struck over the mid-lumbar region first with the bar a blow and then, too, with the back of an axe. The animal came out of ether more slowly than the previous one. But there was no apparent paralysis, as all the limbs could be easily involved. He was again placed under full ether narcosis and such separated shocks of the axe applied as it would seem must shake all the abdominal entrails from their attachments, if not rupture them. This time when released there was great collapse. The body lay limp and motionless, and for a time—about an hour—it was thought that the traumatism would end mortally. He was placed in a litter and laid aside. The next afternoon, when seen by me, he could move all the limbs, but was unable to raise himself. He refused milk. It appeared here, too, in spite of terrible force employed and the battering that the spine sustained, that the cord escaped, as there was no paralysis of either motion or sensation. The following morning he was found dead.

Diagnosis—Mortal injuries, combined with extensive lesions of the soft parts outside the vertebrae.

Post Mortem Examination, Pathological Anatomy—Over the point at which the blows were sustained the hair had been torn from its roots and

the dermal layer of the cutis, in patches, was rubbed off. The muscular and other tissues under the integuments were, in places, reduced to a pulp on the surface, but the deeper layers, though everywhere saturated with blood, were entire. There was no fracture. The arachnoid and pia were deeply congested. Those of the latter, particularly, were greatly distended. Microscopically there was no lesion of the medullary substance. The worst damage had been done to the abdominal viscera. The right kidney had been dislocated forward and downward by an enormous effusion of blood into the loose retro-peritoneal tissues. The liver was nearly rent in two by a laceration which passed in a vertical direction through the right lobe. This, too, gave issue to an immense extravasate of blood into the peritoneal cavity. This case abundantly substantiates my observations and conclusions in connection with serious lumbar lesions which are consequent to traumatism, viz.: That with violent commotion sustained here the spinal cord is the last to yield, and that one may sustain very serious and extensive damage to the organs in the abdominal cavity, the cord entirely escaping. The most common in all these cases, as well as those in the lower dorsal region, is renal complication. And when the viscera escapes then disorganization to the muscular stays externally, with consequent weakness, wasting and ankylosis, are common sequelae.

Ninth Experiment—In this experiment the aim was to determine the effect of direct concussive injury over the dorsal spine. It will be observed that the dorsal spine is only in a measure movable; that the cord here is the most superficial; but it is well protected against commotion by the underlying elastic, pneumatic cushions on either side, the lungs. The animal, a young female cat, was held similarly to the manner in which the one was in the lumbar traumatisms. Now, ten violent blows were struck in the mid-dorsal region by the iron bar. The animal came out of the ether slowly, but there was no paralysis. The next three days, although she was sensitive to the prick of a pin in the extremities and moved them about, yet she was unable to raise her feet. On the fifth day she had quite recovered from the immediate effects of the injury and was able to again walk. Killed on this day.

Diagnosis—Extensive contusion of the soft parts; injury entirely eccentric.

Post Mortem Examination—The only lesion of importance, exclusive of those seated in the soft parts, was a small hemorrhage into the perithecal spaces. This was small in amount and was partly reabsorbed. The theca, with its underlying envelopes, with the cord, entirely escaped injury. This case also demonstrated how violent and repeated traumatic force must be to compromise the cord; and, further, that one may, with entire impunity, escape spinal symptoms of palsy with a moderate effusion of blood into the spinal canal.

Tenth Experiment—In this experiment the contusive force was delivered just above the dorso-lumbar junction. The purpose in view was to determine whether the spine here could be violently concussed with sufficient energy to disorganize it without fracture, or inducing, simultaneously, extensive internal injury. For, in my experience, serious spinal injuries in this situation almost invariably lead to pronounced renal complications and other visceral disorganization.

The animal, of mature growth, under ether, was adjusted as the pre-

ceding, and four blows with the full force of the iron bar applied, just above the first lumbar vertebra. Animal released, soon recovered consciousness, with power of motion in all the limbs. Again etherized. This time three blows with the back of an axe, coming in full force, a little higher. Animal in deep collapse, laid aside. The next day paraplegia complete, but could drag its body along on its abdomen with its fore legs. Drank milk freely. The following day was less lively, refused food and lay on its side. The third day in about the same condition, but weaker.

Diagnosis—Probable fracture, with hemorrhage, consecutive meningitis and softening of the cord.

Animal killed on afternoon of this day.

Post Mortem—On division of the integument everything was found saturated with partly organized blood clot, the haematin which had escaped from the vessels having discolored a large area of the aponeurotic tissues. The spinous processes of the two lower dorsal vertebrae had been fractured, so that on the elevation of the fragments free hemorrhage issued from the spinal canal, which, on removal, left the dura-mater nude and exposed. There was a large hemorrhage into the spinal canal which, in places close to the site of injury, visably compressed the cord. On division of the dura the arachnoid membrane was seen deeply congested. Opening this with the scissors it was apparent that the medullary substance had sustained peripheral disorganization, as it was deeply stained and rent in several places by linear lacerations. For a considerable area it was so much softened that it could not be handled after the dura-mater had been removed. On opening the abdominal cavity a laceration of the liver, extending through the convex surface of the right lobe, was met. This was about half an inch deep in a vertical direction. There was a free hemorrhage into the retro-peritoneal tissues. There was fluid blood in small quantity in the pelvis of each kidney. In the right pleural cavity there were about two ounces of blood, of a fluid consistence. The lung was slightly displaced upward, and both the costal and pulmonary pleurae were adherent. On removing the spinal cord there were everywhere distinctly seen well-marked traces of meningitis, in some districts more marked than in others, though the most abundant effusion of coagulable lymph was found in that segment above the point of injury. The results of trauma in this case were substantially the same as those encountered and enumerated in the preceding, and go to support the view that a trauma, to involve the cord direct, must, with few if any exceptions, extend into and carry its disorganizing effects through the underlying cavities.

Eleventh Experiment—In the next experiment it was attempted to determine what degree of concussive force, direct, the mobile cervical spine could sustain without fracture, dislocation or disorganization of the spinal marrow. As this is the most vital region of the spine, providing as alone can force be applied directly laterally to the column. It may also be it does, the chief nerve supply to the respiratory muscles, it was clearly apprehended that the force necessary to involve the cord might cause instant death or that the animal would not survive the trauma long enough for the secondary or inflammatory phenomena to develop. In this region alone can force be applied directly latterly to the column. It may also be

reached anteriorly, but under these circumstances injury must be attended with mortal effects through damage to the cranial and sympathetic nerve trunks compressed against the bodies of the vertebrae.

A full-grown female cat was firmly fixed from the shoulders down, while the head was held with the hands. Now, three blows were struck in quick succession against each side of the neck over the tips of the transverse processes. The same ten-pound bar was used as in the preceding experiments. As the effects of ether passed off it was noticed that no paralysis followed. Again immediately anaesthetized. This time, after one blow was delivered on the dorsum of the spine (cervical), and the head was freed, when there seemed on pressure as if there had been a luxation and fracture. Animal now in profound shock and apparently moribund. The following morning conscious but wholly paralyzed in the extremities. Animal breathed in gasps, mouth widely opened, discharging from the mouth blood-tinged saliva, eyeballs protruding, with widely dilated pupils, heart beats with a quick, fluttering thrill. Died the next morning.

Diagnosis—Extensive eccentric and centric spinal injuries, fracture, dislocation, with displacement, hemorrhage and general shock.

Post mortem Examination—Pathological changes, extensive hemorrhage under the integuments, laceration of muscle, fascia and ligament, fracture through the lateral arches of the fourth cervical vertebra, with lateral and posterior displacement of the body over the articular surface of the fifth cervical vertebra, free hemorrhage into the spinal canal and sub-arachnoid space, laceration of the dura-mater, hemorrhagic infiltration into the medullary substance (haemato-myelia.)

This case was of a kind seldom met as an accidental condition in man. I have never seen but one similar, and in this case, though the lesions were quite identical, it was not caused by a blow while the body was in a state of inertia, but by the body itself being in motion and striking with violence on a hard, resisting substance. There was a concentration of force in this latter experiment which spent itself on vital centers, and, though there was marked shock, from which the animal never rallied, yet there were abundant disorganizing lesions to account for it.

Twelfth Experiment—In this experiment it was intended to study the immediate effects of concentrated direct concussive force, applied directly over the thachea on the anterior aspect of the spine with the head extended.

A male cat was employed, the trunk fixed, the head horizontally. Four blows were inflicted with the iron bar, being brought to bear with full force, between the lower jaw and sternum. Animal deeply shocked, breathing in irregular gasps for a few moments only, when he was dead.

Diagnosis—Concussion of the vagus, with consecutive cardiac and pulmonary inhibition, traumatism of peripheral vital organs, eccentric to the central medullary substance of the cord, probable luxation of one or more vertebrae, etc.

Post Mortem Examination—Morbidity anatomy. As this animal had been unavoidably killed, almost outright, there was no time for pathological changes to set in. Those changes which were met were the outcome of chemical mutations before autopsy, which was made the day after injury. In this examination the first incision was made anteriorly in the long axis of the trachea. There was no hemorrhage immediately beneath the integument, but under the deep cervical fascia on the right side everything was deluged with dark, tarry blood. The large hyoid muscles on both sides,

in their centers, were lacerated, and their sheaths were distended at the point of laceration with blood. There was no tearing of the cervical nerves nor in those of a cranial origin noticed. The right jugular vein was the seat of a rent, about 2 c. c. in length, close to the sternum. Now the bodies of the cervical vertebrae were exposed. No fracture was discovered or displacement of bone, except at the atlas-axoid junction, at which point there was a distinct osseous diastasis, with a fracture of the odontoid process, with no displacement. Spinal canal stuffed with blood, and within the theca, at the insertions of the ligamenta-dentata, there were diffused petechial ecchymoses, covering the adjacent surfaces of the pia-mater. There was a distinct laceration of the spinal marrow, extending in an oblique direction through about one-third the thickness of the bulbar expansion, from which the brachial-plexus is given off. The lesions found post-mortem in this case were similar to those which are caused in the execution of man by hanging, when the hangman attempts at the same instant to destroy the canal of the spine and trachea. The wound of the jugular vein, no doubt, was caused by the sudden direct contusive force directly applied over it. The respiration-spinal injuries here artificially induced are seldom witnessed in man, the nearest I have ever seen being one case which has been given in detail, in which two wheels of a vendor's wagon passed over the throat while the man was lying on his back, seriously injuring the vocal and respiratory organs without involving the spine seriously.

PUNCTURED AND LACERATED WOUNDS OF THE SPINAL CORD.—EXPERIMENTATION ON THE SPINES OF DOGS IN WHICH PENETRATING WOUNDS WERE INFLICTED UNDER ANAESTHETICS.

Punctured wounds or injuries of the spinal cord are exceedingly rare. In the surgical records of the late War of the Rebellion there are but two authenticated cases mentioned, and, as both of these recovered, there might seem room for doubt as to the accuracy of the diagnosis. As a matter of fact, it is impossible to bayonet or puncture any part of the spinal cord, except in the occipito-atloid space, without fracturing or shattering the bone. The imbricated arrangement of the borders of the posterior arches closes in, compactly and completely, the canal. The triangular shape of the posterior arch, with its sharp, conical outline, formed by the serial tips of the spinous processes throughout the entire length of the spine, serves as the most effective defensive barrier against damage to the cord by penetrating weapons from behind, by deflecting the point of the vulnerable agent to either side against the most powerful constituent part of the rachidian column, the spinal bodies. If one have but a second's intimation of danger of a penetration of the occipito-atloid space, the depressed occiput renders a puncture impossible through the hiatus without the brunt of force being first spent on the cranial base posteriorly. But, as a puncture of the human spinal cord can be regarded only as one of the rarest surgical curiosities at the present time, their systematic and minute study has comparatively but little value; hence, in his line of experimental study, my observa-

tions were limited to only five dogs. While on this study of punctured and lacerated wounds of the spinal cord in the lower animal the opportunity was taken advantage of to make a critical study of every phase of spinal hemorrhage. I have taken the position that a primary hemorrhage into the medullary substance is seldom or never witnessed as a consequence of trauma, except when complicated with fracture.

There is a vast difference in the experimental work on concussive and punctured wounds of the spinal cord, for, with one, we may kill the animal by a fall or blow, and the entire cord escape, while, with the other our technique is direct and precise. It may not be remiss to remark here, before my experiments are cited, that in them there were many revelations evolved quite unexpected and unsought for; yet of great interest and practical value in connection with the question of operative surgery in certain spinal traumatism, and the usual situation of hemorrhage in spinal injuries. It may be said that with these experiments every possible precaution was taken to inflict the least possible pain and operate only under complete anaesthesia. After operation the animals were comfortably housed and carefully fed. As regards the protracted sufferings of the animals, besides a fear of exposure, prevented us from keeping them alive over a considerable period of time.

First Experiment (on dogs)—April 2d, 1893. The dog weighed about 40 pounds, a bull setter. Under ether. Hair clipped over the spines of the last dorsal and first lumbar vertebrae; skin soaped, scrubbed, washed and shaved. Our first experiment was to determine the effects of puncture of the cord. With this end in view a long stylet was passed down and an effort made to enter the canal through some of the intervertebral spaces, but this could not be done. Hence, the stylet was passed directly through the bony coverings of the cord. As its point passed through the column it was pushed on through until it was felt to engage in the body anteriorly. It was now quickly withdrawn. A few drops of blood issued from the puncture. Antiseptic dressings were applied. Dog rallied quickly. Half an hour later he walked about as lively as ever. This dog was kept under observation for two days. No paralysis of any description—hearty, active, and wants to escape. On the third day after first experiment again was anaesthetized. This time the tissues were cut down on over the parts which we had denuded of hair previously, the last dorsal and first lumbar, the posterior arches of the two vertebrae hewed away and the cord exposed, when the dura-mater for an inch in length was divided, the arachnoid thus coming into view. Now the wound was thoroughly drenched and partly closed in, dressings applied and the dog returned to his kennel. At this stage it may be worth while to briefly recapitulate a few features on the technique of this so-called laminectomy. We encountered two great difficulties in the way, the first being hemorrhage. The soft parts overlying the spinal apophyses were vascular enough, but as we gnawed through the osseoligamentous structures of the spine and tore open the rachidian plexus of vessels, blood issued up through the opening in great quantities. Indeed, it was feared the animal would bleed to death before we could expose the cord. The vessels were so deep-seated and their spouting mouths so retracted into the innumerable bony nooks and notches that it was impossible to catch them with the forceps. Firm and protracted pressure alone controlled them, when the theca came into view. On division of this there was some oozing, but it was easily controlled. Next to

the arrest of hemorrhage, the difficulty is in dealing with the osseous envelope. The division of the posterior, laminated arches of the spinal column is an operation attended with the greatest difficulties, and is certain to damage the spinal cord when performed by the inexperienced or careless. But when performed by the most skilled the cord may suffer injury. It is a tedious operation, and cannot be performed without inflicting great shock to the system. After the explorations of the canal, its bony envelope at this point is gone forever; a loss, perhaps, not so seriously felt with the lower animal as in the vertebral column in man. After the canal and dura-mater were opened and we proceeded to suture the wound, we found that we could not fill in the breach made by the removal of the bone, except, on the surface, with the integument, which could be stretched over it. Our dog reacted very slowly after operation. He was unable to raise on his fore paws until the following morning. Now the poor animal was entirely paraplegic, and had incontinence of urine and faeces. He dragged himself about on his fore paws, but he was terribly weak and staggered as he moved. He seemed to notice nothing and refused to eat, though he drank freely of water. On the third day his condition rather improved, as he commenced to eat and look brighter. His temperature was 102.3-4 degrees. On this day he was killed under ether, by puncture of the medulla-oblongata.

Post Mortem Examination—On autopsy our purpose only was to examine the cord at the site, in which it was transfixated by the stylet, and that part from which the laminae had been detached. On longitudinal and cross section of the cord there was no evidence discovered of softening or disintegration; though there was extensive meningitis.

Comments—It seemed to me that this experiment most conclusively determined several things of importance, to be comprehended by the pathologist and surgeon. In our first experiment it clearly decided that the mere puncture of the spinal cord is devoid of serious danger and will not produce paralysis. Our second experiment on this animal brought out, very strongly, the great dangers and difficulties in the operation of laminectomy; from hemorrhage; from crushing the bone and removing it; and from the exposure of the cord, for, in this experiment, in which complete paralysis of the hind legs followed, there was no evidence that the cord had sustained any mutilation through operative technique or removal of bone-substance, etc. The shock in operation and exposure of the cord to atmospheric influences seemed to be quite enough to induce the full paraplegia.

Second experiment. The animal was experimented on, as the preceding, twice, and on the same dates. He was a large bull spaniel, weighing 50 pounds or more. My first experiment on him was identical with the first on the other dog, except that the puncture through the cord was further down and was repeated once, making two punctures. This animal, as the preceding, as he came out of the ether had full use of his limbs, without a trace of paraplegia. After four days' rest, not in the least disturbed by the two punctures which passed clear through the spinal cord, he was again taken in hand. The experiment now was for the sole purpose of determining on the living animal the most common seat of rachidian hemorrhage when resulting from trauma. As, in the preceding case, we had to encounter a large hemorrhage from the extra thecal, vascular supply. My

aim here was to determine the vascular quality of the medullary substance by direct puncture under the naked eye on the living animal. The cord having been exposed with the dura-mater, easily withing touch, a needle four inches long was first pressed into the medullary substance, through the meninges, then it was withdrawn and introduced again, in a vertical and downward direction, when it was withdrawn. The wound was now closed in the usual manner.

Dog in deep shock; rallied the next day. This dog was old and hence the eburnated, stony hardness of the spinous apophyses in excision made, the task of trephining one of great difficulty and proportionate shock. He, too, had paraplegia and fared worse than the other animal. His fever went up to 104 3-4 degrees on the second day, and he developed active septic symptoms. The wound became horribly foul. Was killed with the other animal, in the same manner.

Post Mortem Examination—Autopsy was limited to the inspection of the segment of the cord, which had been punctured with the needle, and more or less lacerated by it. This segment was removed, entire. It was exhibited, with a history of the case, before the Neurological section of the New York Academy of Medicine, by me on April 14, 1893, in support of my former position, that primary hemorrhage into the spinal substance as a result of trauma, rarely if ever happened. On splitting the dura, a small, oblong blood clot was found, lodged between the dura and arachnoid in the arachnoid space. There was no hemorrhage into the medulla-spinalis, which, was perceptible to the naked eye.

Third Experiment—Medium-sized Scotch terrier. This experiment was instituted to determine the extent of puncture the spinal cord could sustain, without serious interference of function, and, incidentally, observe the vascularity of the various structures of the cord.

April 17, 1893. Dog etherized, when there were two deep punctures made on each side of the spinal processes of the ninth and tenth dorsal vertebrae. The stylet, which had a blade four inches long, with a sharp sword-point, was plunged in, up to the handle. Its tip was felt to penetrate the spinal canal, in each instance, when, it was pushed through anteriorly, until, it engaged in the spinous body, when it was withdrawn. The dog came out of ether promptly, with full power over all the limbs.

April 19th. Temperature 102 1-2 degrees; tissues over the point of puncture tumefied and very sensitive. He was again fully etherized and this time, ten punctures, similar to the first four, made, through the entire length of the spine, to and through the occipito-atloid space, above where the others had been made. Came out of the ether, more slowly than previously. Within half an hour on all his feet, no disturbance in locomotion.

April 22d. Temperature 104 1-5 degrees, entire area of the back from the root of the tail to the occiput tumefied. Dog's general condition was good, though has fever. No signs of paralysis. Was again etherized and strangled by hanging.

Post Mortem Examination—April 24th, two days after death, the entire spinal cord was stripped, from end to end, commencing above, by sawing away the base of the occiput; so that the entire cerebellum and medulla-oblongata could be removed with their meningeal investments. It was found that in the fourteen punctures made, but nine of them penetrated the spinal cord, and only seven of these penetrated the medullary substance, two passing between the theca and bony wall of the canal.

The only manner by which these punctures could be detected, was by the small effusion of blood; in some places fluid and in others, coagulated, where, the vessels in the extra-theal tissues and theca, were pierced. The cord having been lifted out of the canal, was exposed to a bright light, in order that it might be critically inspected. There was not a trace of hemorrhage into the white or gray substance of it that could be discerned with the naked eye, even in the medulla-oblongata, which was pierced in three places. This experiment demonstrated how difficult it is to puncture the spinal-cord by any sort of instrument, even when one has become fairly familiar with the anatomical land-marks, by experience and practice. In those fourteen punctures made with all care and exactness, in but nine was the cord wounded; and in but seven, or half, the spinal marrow was touched. When it is remembered that the spinal canal has its greatest diameters, latterly; that the cord, but little more than half fills this canal, and, that its inclination in some animals is more to one side than the other, and even varies in the same animal in different districts, in position, it can be easily perceived how this difficulty of penetration obtains. The multiple punctures produced no paralysis. They produced no hemorrhage into the medullary substance, and but very little in any of the tissues within the canal.

This experiment conclusively proves, that the spinal cord may be punctured, directly, in one or more places, without detriment to function; that it is only when extensive mutilation of the nerve fibers is produced by giving the instrument an oscillating or twisting motion, extensive disorganization of the nerve-substance is affected and paralysis follows. It also further confirms my previous position, that the white and gray substances of the cord are not vascular tissues and can seldom, by any species of violence, be a seat of primary hemorrhage.

Fourth Experiment—A fully developed, rather old, but powerful bull-terrier dog was secured and etherized. My purpose in this instance was to expose the cord in the mid-dorsal region (its most vascular district, this being the center of its lateral supply from the vertebral branches of the intercostal arteries), and divide the nerve-roots, in order that the cord might be lifted out of its bed; then, being fixed, to make a complete section of it, and determine under the naked eye the extent of hemorrhage from it when divided. This would constitute the most crucial test of all, in the way of proving the extent of vascularity, in the nude, medullary ends, of the cleft cord. In the course of operation two very formidable obstacles, had to be overcome, to a greater extent insurmountable, than in any of the preceding. One of them was the enormous hemorrhage which issued from every direction when the vertebral apophyses were reached. It occupied considerable time subducing it before we could commence the necessary laminectomies for the exposure of the cord. Here we encountered an unexpected second difficulty; for the overlying vertebral-apophyses were as hard and unyielding as ivory, and hence their detachment was accomplished only by a very tedious and forcible crushing separation, with a powerful bone-pliers and rongeur. Indeed, it was quite impossible to effect this step, without the infliction of shock and some damage to the cord. It is quite out of the question to employ a laminectomy saw in the very narrow, deep cavity in which we had to manipulate. About three inches of the cord were exposed, when its roots were divided and it was carefully raised out of its bed, in the spinal canal. Sufficient tension was applied, so that nearly an inch of slack was brought out. Now,

two tenacula were inserted, transfixing the cord, each about an inch apart and held in position, until the nerve-cylinder and meninges were cut through. At this stage, a fine soft sponge was introduced, and the ends perfectly dried. There was some slight oozing from the cut ends of the theca, arachnoid and pia; but from the spinal marrow, not a drop. The tenacula were now removed, when, at once, the divided ends of the cord retracted into the canal quite out of sight, leaving a hiatus at the point of section. On minute inspection it was seen that, though all the thecal envelopes of the cord possess well-marked contractile properties, in the arachnoid and pia, this is more evident. In this instance, the medullary-substance had receded further than its overlying fibrous envelope. This experiment, further, had more definitely settled the question of the vascularity of the cord, and illustrated its elastic properties, which are about the same as an artery.

Fifth Experiment—The animal on which this experiment was made was a large dog, a cross between a spaniel and a mastiff, and would weigh nearly a hundred pounds. This was the last animal on which I made experiments on puncture of the cord. My aim here was to once more determine the vulnerability of the cord by direct lesions of the meninges. Besides it was my intention, in a second experiment on this animal, to do a laminectomy, divide the theca, resect a part of the medullary-substance, then close in the dura, with the wound, through the soft parts, and watch the effects, immediate and ultimate.

In the first experiment, as the manipulations occupied but a moment, the animal was but partly anaesthetized. Now, the hair over the lower dorsal region was clipped closely with the shears, when a strong spear-pointed stylet was pressed into the spinal canal and the cord, in the interspaces, between the ninth and tenth and tenth and eleventh dorsal-vertebrae. Every possible aseptic precaution was taken in this instance not to infect the punctured wounds. In this instance no effort was made to give the point of the stylet a lateral, or rotatory motion, and disorganize the marrow; in other words, our efforts were directed for one objective purpose only, viz.: to further demonstrate if the spinal cord could be punctured, pierced or lacerated through and through without any functional derangements resulting. As the stylet was withdrawn in each case a drop or two of blood welled up, along its track. After four punctures had been made the animal quickly recovered himself, without the slightest trace of paralysis. For the four succeeding days it was clear that the spinal cord sustained no serious damage; for he had a full power over all his limbs. He had no rise in temperature, eat heartily, and struggled hard to get away.

On the fifth day after experimentation he was again taken in hand, this time, for the more crucial and difficult experiment of endeavoring to resect the lamina of the first and second dorsal vertebrae, opening the cavity of the arachnoid and exsecting a portion of the medullary substance and closing up the wound. The animal was quite docile before anaesthesia was commenced. As the operative manipulations which were required in this instance would be of an extremely tedious and delicate character, it was necessary to press narcosis to full coma. But this was found quite impossible. Though more than eight ounces of ether were given, yet the animal struggled with such energy that it required four men to hold him down, and at no time could the necessary quiet be secured for operative

measures. It had to be given up, as an impracticable case. He was now killed. The next day a *post mortem* was made.

I may say here, that the quickest and easiest way to open the spinal cord of an animal, or man, on autopsy, is, to cut away the ribs on either side with all the soft parts detached, when the entire column is removed, *en masse*, from the sacrum to the occiput. This gives one an opportunity to open the canal through its entire extent, without damage to the cord, with ease and rapidity.

In the spinal canal of this animal, immediately at the seat of puncture, for a distance of about four inches, there was a bloody extravasate into the spinal canal, outside the theca, which had undergone partial organization. This could be easily lifted away entire. Four minute punctate openings through the dura could be seen. There was a distinct zone of discoloration, close to the margin of each; besides a staining of the meninges, for a distance from their margins of from three to five m. m. On division of the cord, to the naked eye there were no gross changes observable in the medullary-substance, although there had been some slight escape into the cavity of the arachnoid of a sanguineous fluid. This case again clearly and conclusively demonstrates that puncture and repuncture of the spinal-cord are not incompatible with its full functional integrity; provided, the wound be thoroughly aseptic and there has not been extensive destruction of the overlying bony walls. This series of five experiments were an ample number, to enable me to determine the remarkable vulnerable resistance, which the spinal cord manifests; and, refutes the commonly prevailing notion, that a prick or puncture of the spinal cord is mortal in its consequences. Indeed, it may be laid down almost as a dogma, that the puncture of the paranchy-matous elements of the spinal cord, like that of any other viscus in the body, is practically an innocuous procedure; and, only becomes dangerous, through an extensive hemorrhage, or what is most common, through infection.

This line of investigation, also, has given ocular proof of the avascularity of the spinal cord substance, and demonstrated the most common situation of spinal hemorrhage, showing, that, when its origin is venous, its development is gradual and its volume moderate, and, local in situation. While, on the contrary, when arterial, its onset is sudden, and its quantity so great as to exercise compressive power and threaten life.

MISCELLANEOUS EXPERIMENTS ON THE SPINES OF FIVE DOGS.

Although it would seem that ample experimentation had been made on the spines of the cat to clear up any question with reference to tortion or compressive injuries, yet, as their spinal cord is so very diminutive and the entire back is so eel-like in elasticity, that it occurred to me, advisable, to extend this line of experimentation to the spine of the dog for a fuller verification of the conclusions reached on preceding pages.

Sixth Experiment—The object of this experiment was to determine again, if the spine could be fractured without any paralysis resulting. This is an important question to decide, inasmuch as there are surgeons who recommend an incision on the fractured bone in every case, particularly

when paralysis is present. But we may and do often have fracture, with spinal hemorrhage, and paralysis in which, the fractured bone, in no manner, whatever, impinges on the cord.

The dog, a medium-sized terrier, weighing about twenty pounds, was anaesthetized, then placed squarely on his belly, thorax and neck, and firmly held; while one slowly raised the hips and sacral spine, and suddenly bent it, with great force, over, on the shoulders. Under the hand, simultaneous with this movement, a tearing and giving way of the tissues were easily perceived with the hand, while a loud fracture of bone could be heard by all those in the room. This animal's back had been completely fractured, in its lower dorsal segment. The animal came from under ether promptly and ran about, as spry as ever, without the least appearance of paralysis. Four days later she was killed. But at no time during those four days was there paralysis of any description; and, though there was an elevation of temperature to 102 on the second day, she preserved her vivacity and appetite.

Post Mortem examination was made on the second day after death. The entire spinal column was removed, from the sacrum to the occiput, first. When this was done, it was evident that there had been some free hemorrhage into the posterior-mediastinum and right pleural cavity. Now, on examining the spinal apophyses, on the posterior and lateral aspects of the column, over the point on which the greatest violence had been sustained, it was at first thought, there had had been no complete fracture anywhere. But, on turning over the spine and presenting it on its anterior aspect, it was found that the body of the tenth dorsal vertebra had been fractured completely, through, the anterior ligament having given way, immediately, over the fracture. The spinal canal, on a backward flexure, opened widely, so that the nude, pale dura-mater came into view. Both transverse processes had been completely fractured, but were held so firmly in place by the ligaments, that on external examination these fractures could not be detected. The cord had been put on severe tension and subjected to considerable pressure, but it nowhere showed signs of damage.

This case, of all others, conclusively proved:

First—That the spine may sustain an extensive fracture without paralysis following, as a necessary sequela.

Second—That the cord possesses, in a high degree, the dual property of extension and compression. That spinal fracture is not incompatible with medullary integrity, and, finally, that there can be no doubt but a fracture of the bones of the spine, one or several of them, possess the properties of union and regeneration, as other bones of the body, accordingly, should be treated by rest, and, by similar principles as guide us in fracture elsewhere.

It demonstrates, too, that the bones are more fragile and weaker than the ligaments, and hence, why, when fracture does occur in the rachidian injuries, there is less disposition to displacement than is seen elsewhere.

Seventh Experiment—A middle-sized bull-dog bitch was selected. In this instance my purpose was to determine, if possible, the effects of denuding the spinal cord, dividing the theca and draining away the cerebro-spinal fluid. In operative manipulations great care was taken to observe the strictest precautions and expose the cord with the least possible damage to it. Therefore, we employed only the best instruments, viz.: the straight and curved rongeurs, with fine cutting pliers. No hemorrhage of any con-

sequence was encountered, until we commenced to detach the vertebral-apophyses, when the escape was very large. We had to discontinue for some time to staunch it. The section was made through the posterior arches when the bones were more easily cut through, and the cord exposed. When all hemorrhage had ceased, and the pinkish, white surface of the theca came into view, it was divided through about two cm. in its long axis. At once, there was a free issue of an abundant blood-stained serous fluid. When this ceased the caliber of the cord seemed distinctly reduced, probably through the loss or escape of its aqueous covering. Now, the parts were closed in, in four separate layers, and antiseptic dressing applied. As she came out of the ether it was apparent that she was completely paraplegic. The following day paraplegic, seriously ill and declines food and drink. Died the next afternoon, after having several convulsions.

Post Mortem Examination—On the second day after death an autopsy was made. On removing the dressings it was seen that the tissues in the region of the wound were infected, tumefied and giving issue to a free, purulent discharge. The spinal marrow showed clear evidences of extensive changes, and throughout was the seat of red-softening. The meninges were opaque, thickened and congested, the inner surface of the arachnoid being the seat of a pale, flocculent deposit of a plastic character. The brain was now opened. The objects for which, this experiment was instituted were in part at least, frustrated by the septic changes, which so soon set in, in spite of our precautions.

There was one thing, however, partly settled by it, viz.: that any operation on the rachidian-structures which entail a section of the spinal canal and an opening of the theca-vertebralis, is not without danger to the organic functions. Here, though the medullary tissue was in no manner crushed or seemingly mutilated, yet, on closure of the wound, and as soon as the animal came out of ether, he was completely paraplegic. But, it might be alleged, that the linear incision of the medullary-substance, or draining away, of the cerebro-spinal fluid would account for it. But, inasmuch, as the same phenomena have followed, previously, when the meninges and cord-substance was in no manner disturbed, it is rational to assume, that the exposure of the cord alone, was enough to account for them. It is a notorious fact, that the rendering of a simple, a compound fracture, always adds to the seriousness of the injury, both in the way of developing fresh dangers, and, at best, by very considerably delaying union. In the light of this and other previous experiments it is evident that surgical intervention, as a means of treating fractures of the spine, when a free incision is made, must always be regarded, as a very serious procedure; in fact, a *dernier ressort*, which can never be justified as a mere exploratory measure, and hence, only permissible when all hope for relief, through other sources, have failed.

Eighth Experiment—Again we essayed to determine, by a repetition of a former experiment, if fracture of the spine was compatible with the full functional integrity of the spinal cord.

A full-sized terrier pug, male dog, was secured for the purpose. Having been etherized, he was lain with hind and forward legs spread out, flat on his abdomen and thorax. Now, the cervical and upper dorsal segments of the spine, were immovably fixed, when the hind legs and sacrum were seized and the entire pelvis and lumbar-segment crowded over, on the shoulders. This required great force, first, in steadying the spine above, and next, in making the necessary forced dorsal flexion. Finally, when ex-

tremor flexion was reached, and a sudden, violent motion was made, a loud crack was heard, and the tissues were distinctly felt to sunder and give way under the hand, at the situation of the fracture. It seemed as though the dog's back was broken completely into, through violence inflicted. The dog came out of ether quickly, and after a moment of groggy staggering, walked about, without a trace of paralysis. Fed well, drank well, and seemed in his usual health, for the next two days, when he was killed.

Post Mortem Examination—The animal's spine was first taken out entire. There was free hemorrhage into the right pleural cavity. At the junction of the eighth and ninth dorsal vertebrae there was an extensive rupture of the ligaments, an abundant hemorrhage into and through the spinal canal, through a rent in the anterior common-ligament, and into the pleura. There was no fracture and no damage to the spinal cord. This was a case of fracture, or, rupture of the ligament instead of bone. The dog was young and the bones were wanting that brittleness and fragility, so often met with, in those more advanced in age. It is almost needless to add that, in this case, as in all others of a similar class here reported, the extrinsic parts suffered serious damage. The injury inflicted was just as great, as though bone had been disorganized. The free hemorrhage into the spinal canal is a characteristic feature of all severe spinal injuries, and here we see that, though the effusion was considerable, no paralysis was produced. On division and section of the spinal cord not the slightest trace of sanguineous extravasation could be discovered, in the gray or white matter.

Ninth Experiment—A medium-sized male setter was provided for the next experiment. In this instance, it was our purpose, to induce a fracture in the upper dorsal segment, in about the middle of the scapulae, and watch the effects. The animal was fully etherized and placed in a fixed position, similar to the preceding. Now, as the sacral, lumbar and lower-dorsal regions, were held, firmly down, the head, neck and shoulders were raised, and, slowly but forcibly bent backwards, with a concentrated crushing force, until a loud crack was heard and the back was fractured completely through, at the apex of the angle. The increased mobility at the point of fracture, made it evident, that there had been extensive laceration and rupture of muscle and ligament. The dog came out of the ether well, and, in a few moments, walked about, without the slightest impediment. His general condition, remained fairly good, for the next two days, during which time there was not the slightest impediment in locomotion.

Post Mortem Examination—The entire spinal column was removed first. There had been an extensive hemorrhage into both pleural cavities, with free hemorrhage into all the tissues, contiguous with the spinal column at the seat of injury. Immediately, through the body of the fifth dorsal vertebra, there was a complete fracture, with laceration of the anterior and lateral ligaments in this situation. On flexing the spine in a posterior direction the bare, spinal cord, came into view, through the aperture beneath the fissured cancellous substance. The spinal canal, for two or three inches above and below the point of fracture, was partly filled by a blood clot. It appeared that the large sanguineous effusion into the cavities had come from the rachidian vessels. Besides, the fracture through the center of the body of the vertebra, there was also, fracture through both transverse processes, close to their pedicles; though, there had been not the least degree of displacement, and were so devoid of crepitation on motion,

that it would have been entirely overlooked had not all the overlying soft parts been dissected away, and the parts exposed to view.

Comments—This was another typical case of fracture of the spine in which no symptoms of paralysis supervened, and, though the rachidian column was nearly rent in two, there was no evidence of any hemorrhage, into the medullary substance; thus demonstrating incontestably and beyond cavil, that nothing short of direct mutilation of the spinal marrow, that a fracture by indirect force is, *per se*, of serious moment, unless, there are present, other serious, complicating factors. The hemorrhage into the chest, no doubt, would have undergone resorption and disappeared without inducing any pulmonary complications. The small extravasate into the spinal canal, in no manner, disturbed nerve function. Again, we saw here, another example of this class of fractures of the spine, which justify no interference. There were, the bodies torn in two, an osseous block disorganized at its center and a double fracture induced; yet, no displacement; but replacement so to speak, *i. e.*, as soon as the violent tension which sundered and separated the spinal structures was removed, the released fragments immediately sprung back into their own places.

Tenth Experiment—I might say here, that we found it quite impossible, to fracture any part of the lumbar-vertebrae in the dog by compression, force, twists or other forcible distortions. In this, our last experiment, we attempted to determine if the lumbar-region would sustain the consequences after the fracture and bear it with as much impunity as did the thoracic region.

A full-grown, cross-breed terrier setter was secured. His weight was about forty pounds. My purpose was to fracture without dislocating. The latter could be easily accomplished in the cervical region by simply twisting the head on the neck, at the atlo-axoid junction. This dog seemed to have an instinctive fear of danger, so that from the time of capture, he kept up such a loud, plaintive howl as to attract the notice of passers-by and residents in the neighborhood, and make his keeper, who was now in danger of arrest, very anxious to dispose of him. He was fully anaesthetized, after a most marvelous resistance, which quite exhausted four men. Now, with the body fixed on its side, the neck was forcibly twisted in its lower segment, and suddenly bent at an acute angle over the edge of a narrow block. This accomplished nothing, with the powerful composition of his neck. Twice repeated with the same results. Not to be defeated in our attempts now, the neck was fixed and the trunk employed as a fulcrum. This succeeded, as a distinct dissundering was felt under the hand, and a crack was heard. It was supposed that the fourth and fifth cervical vertebrae were fractured. This animal had consumed nearly half a pound of ether, and after the extended, violent application of force, it was feared that he would expire, without regaining consciousness. But, after about twenty minutes when the ether was discontinued, he was on all his feet again, when he was in a savage mood, and drove away all my assistants, except the one man. He now set up a piteous and unearthly screeching, so that we found it necessary to gag him. He then eagerly sought an aperture of escape. As it seemed quite impracticable to keep him under the circumstances, and continue to experiment on the lumbar region, one hour later he was again etherized, when the occipito-atloid space was punctured repeatedly, but, without inhibiting the respiratory act. He was then asphyxiated by hanging.

Post Mortem Examination—On the third day after death, an autopsy was made. Nothing but the cervical segment and the occiput were examined. No fracture of the spine could be found, except, on the right, inferior, articulating surface, of the fourth cervical vertebra. There had been a transverse fracture, through the superior half, of this disc of bone. There had been some slight sanguineous effusion into the joint, of a fluid character. We were naturally curious to inspect the terminal segment of the spinal cord, where the medulla-oblongata had been pierced. Accordingly, the cord was stripped, by removing the posterior arches, as far as the foramen-magnum. The spinal canal was filled with coagulated blood, throughout the entire cervical segment. The posterior surface of the theca, was blood-stained, and, showed evidence, of having been punctured in several places. Besides, immediately beneath the atlo-axoid space, at which point the stylet pierced it, it was the seat of a free sanguineous extravasate and was extensively disorganized.

Comments—I was heartily pleased that this case ended this series of experiments. In none, did we find it so difficult, to effect vulnerating disorganization, than in the cervical segment. Indeed, in the dog, whose spinal structures anatomically, particularly in the neck, are so unlike the human being, in which, the muscular and ligamentous structures are so powerful, it is quite impossible to carry disorganizing force, down to the osseous structures, without having first practically destroyed, all, the overlying soft parts, anteriorly, as well as posteriorly. Many previous observations have convinced me, that a mere puncture of the oblongata, or, even severed, will not always immediately kill. To be effective, the spinal branches of the vertebral arteries must be opened and the gray substance thoroughly broken up.

CONCLUSIONS.

The results in my latest series of cases in experimentation on the dog, have been of marvelous character, and conclusively demonstrate, that the spinal cord, though, its parenchyma is a pulpy, friable substance, of all the structures in the back, it is the best preserved against injury, and will resist lesion or impairment of its integrity, when its ligamentous and bony-walls, either anteriorly, or posteriorly, have been extensively lacerated, and completely, fractured, through. These experiments also totally nullify and vitiate the rules of diagnosis, in connection with spinal fracture. But, they do not seriously impair the full value of Watson's experiments, and definitely prove that the symptoms of spinal cord injury are always in proportion with the pathological changes. But this dogma enunciated by Watson, will not apply to the coverings and structures, eccentric to the cord. They point besides, to the necessity, of recasting modern views and teachings of neurologists. They again reiterate, and definitely settle, the fact that a haemato-myelia is never a primary lesion after spinal traumatism, for here, in three cases in which the spines were fractured, the preserved spinal cords show, on the most minute inspection, no trace of effusion into the medullary substance. They demonstrate beyond peradventure, that when the spine is fractured by the application of force, of a certain description, as the indirect, this condition is not incompatible, with the full functional integrity of the cord and perfect restoration of mobility and strength, as much, as after a fracture, in any other part of the body.

In those fractures of the last series, it will have been noticed, that there was no displacement of bone. This is a notable and characteristic feature of spinal fracture, in contrast to other fractures in which displacement is the rule.

These experiments illustrate how difficult it is to penetrate the spinal canal by puncture and demonstrate how the cord, in consequence of it, will endure it with entire impunity, when moderate aseptic precautions are taken. A simple puncture of the cord without the fracture of bone, or an extensive hemorrhage, is perfectly harmless on the lower animal; and, from analogical reasoning, it is rational to suppose, that the same statement will apply to man. The paucity of numbers of punctured wounds in the back, which penetrated the cord, in our late war, can probably be accounted for, on the assumption, that their number was much greater than was reported; but, that owing to their general innocuousness, those so injured never reported to the surgeon for treatment, and if they did the latter regarded the wounds as superficial and of insignificant character.

Clinical observations, post-mortem examinations and experimental work, on the spines of man and the lower animals, have taught me that the anatomical elements and tissues which most frequently suffer pathological changes in consequence of traumatic force, regardless of how inflicted, are, in their order of frequency:

First—The vascular.

Second—The osseous.

Third—The neural.

As to structures:

First—The extrensic.

Second—The intrinsic.

Eccentric injuries are common and seldom leave functional impairment.

Intrinsic injuries of the spine are those which involve the cord, are comparatively rare and are seldom seen, except in association with damage to the internal organs.

Hemorrhage into the spinal canal is probably an event more common than is suspected; and, in small quantities, is harmless. Its site, in the vast preponderance of cases, is between the periosteum and theca-vertebralis, and is productive of harm, in proportion to its quantity, and to its situation. Pressure meningitis, myelitis and paralysis are its sequelae, when resorption fails to dispose of it.

Spinal meningeal hemorrhage is an unusual event, for the anatomical reason that the spinal envelopes are, but only, moderately vascular.

Haemato-myleia, or hemorrhage into the medullary substance of the cord, except, as a secondary or consecutive, pathological phenomenon, is never seen. As a primary condition following trauma, I found it impossible to induce, either by submeningeal puncture or even cross section of the cord.

Complete, fracture through the body of a vertebra, or any of its apophyses may occur without succeeding paralysis.

Osseous pressure on the cord, after fracture, is seldom witnessed; nor is it probable that it very often occurs, except in those cases in which the medullary substance at the seat of trauma is greatly disorganized.

Dislocation of a vertebra, without fracture, I was unable to produce in any case.

My experiments, which entailed one or more laminectomies, and exposure of the cord, were all immediately followed by paralysis. At first, it was thought, that in using cutting instruments to remove the posterior arches the cord had been inadvertently damaged. But, *post-mortem* examination of this organ did not support this view; besides, in those operations, in which every possible precaution was observed, the same phenomenon followed. From which, we must infer, that the every act of laying bare the dura-mater, is inimical and often times, disastrous, to the functional activity of the cord.

Injuries of the Cord and Its Envelopes Without Fracture of the Spine—Pathology and Pathological Anatomy.

[By SURGEON SAMUEL C. BENEDICT, Athens, Ga.]

In presenting the subject assigned to me in this discussion. I shall endeavor to confine myself strictly to those pathological conditions which are known to result from railway accidents where the injury is not complicated by fracture, fracture-dislocation or dislocation of the vertebrae. This is as I interpret the intent of the caption of this topic which has been selected for discussion at this meeting. Localization, anatomy and physiology of the cord have been assigned to others who have preceded me, and therefore I shall avoid repetition, except so far as shall be, in my opinion, necessary to a clearer understanding of the pathology and pathological anatomy of the several conditions.

Two general divisions I would make: one where there has been some actual injury, as by blood clot, from bending, twisting, blow, or concussion, if you like; and the other where there was probably no injury to the cord or its coverings, but to the cerebral cortex—the “Traumatic Hysteria” of Thorburn, or “shock,” “neurasthenia” or “concussion” of others.

As we view clearly a section of the spinal cord, made transversely, and with a high power, we find a gray matter and a white. The gray matter is made up of nerve fibres running more or less transversely and emerging from or entering the cord, and connected with these fibres, chiefly in anterior cornua, large multipolar cells, known as ganglion cells. Outside and surrounding the gray matter are what are known as the white tracts, and outside of these, which constitute the cord proper, we find its coverings surrounding it concentrically and longitudinally. These coverings are the pia-mater, arachnoid and dura-mater, just as we find in the brain. Anterior to the gray commissure, and on each side of the anterior fissure, we find a tract known as the anterior column, whose fibres transmit motor impulses; and to the outside of the posterior horns, and laterally, a larger tract known as the crossed pyramidal tract, also transmitting motor impulses. These two tracts convey fibres from either side of the fissure of Rolando, about three-fourths of which decussate at the anterior pyramids of the medulla, and form the crossed pyramidal tracts; the remaining fibres from the cortex passing down without crossing, and forming the anterior motor tract, or the column of Turek, which is not

found in sections lower than the dorsal region. The motor fibres degenerate downward when their normal connection with the cerebral cortex is cut off. In addition to the above function, some fibres in these tracts transmit downwards inhibitory impulses, which keep under control the reflexes of spinal cord segmental centers. Lesions in their course produce paralysis of muscles without loss of nutrition, loss of control over bladder and rectum and increase of tendon reflexes from loss of inhibitory influence from the cortex. The degenerative disease of these columns is known as antero or antero-lateral sclerosis. Lying between the posterior cornua of the gray matter, and on either side of the median line, are the tracts which conduct sensory impulses to the brain from peripheral parts. These tracts are divided into two to each side of the posterior fissure, the column of Goll internally, and Burdach's column external to it. Injury to these columns may originate an ascending sclerosis, the degeneration increasing upwards. In addition to these columns are other tracts connected with sensory fibres which connect the ganglion cells of each segment contiguous, and are known as associating fibres, and are used in co-ordinating motor acts. Degeneration of these tracts takes place in *Tabes Spinalis*, or "*Locomotor Ataxia*." With this brief resume we will consider some of the pathological conditions to which these different parts are liable when injured in railway accidents.

ACUTE SPINAL MENINGITIS.

(*Peri-myelitis—Arachnitis.*)

May be caused by blows, falls, twists or jars in railway accidents. A discussion of the pathology of this disease is best made by a division into three stages.

First Stage—Hyperaemia. We find pia-mater thickened, darkened and opaque, with hemorrhagic spots, and surrounding tissue infiltrated and swollen. The spinal fluid is turbid and increased in quantity. The sub-pia tissue, arachnoid and inner surface of dura congested, and even the cord and nerve roots may be involved in the hyperaemia.

Second Stage—Purulent and Fibrinous Exudation. The spinal fluid is more turbid and sero-purulent, containing fibrin. The pia, sub-pia connective tissue, and that between it and arachnoid, more opaque, softened, with fibrinous and purulent exude containing leucocytes and fibrin. The dura is hyperaemic, reddened and opaque with fibrinous flakes adherent to its inner surface. The cord is in some cases pale and oedematous, or congested and softened diffusely or in spots.

The microscope shows in the soft membranes all the signs of exudative inflammation, as cell-infiltrations fullness of vessels, swelling and spreading of bundles of connective tissue. The nerve fibres themselves are swollen, granular and beginning to break down, the axis cylinders are granular, as also the bundle of root fibres. In the gray substance there may be found swelling of the ganglion cells of anterior cornua. The exudation extends around the cord being thicker in posterior portion and upon columns of Burdach and Goll. The inflammation may be limited to the focal point of injury, or extend longitudinally.

Third Stage—If absorption of the exudate of the second stage does not take place that stage will be followed by the chronic stage, that of degenerative processes liable to affect individual tracts or areas as focal lesions or extending upwards or downwards as sclerotic changes.

Pathology—First Stage—Irregular fever, a quick, hard pulse, pain in the back, limited to focal point or general, at first dull, soon becomes acute, boring or shooting; increased by movement, but not usually by pressure, upon the spines. This pain will often extend around the body making the "girdle pain" of Page. Opisthotonos soon supervenes; there is marked hyper—and parasthesia, muscles hypersensitive, and patient wishes to stay motionless, with stiffened limbs, fearing the acute pain brought on by motion, *not by the reflexes*. Pupils may be irregular; skin reflexes are much exaggerated; passage of handkerchief along spine may originate an opisthotonos. Costive bowels and retention of urine; afterward paralysis of rectal and bladder sphincters; urine filled with urates, and scanty; abdomen tense and shrunken. The duration of this first stage is short—about one week—the pathology then passing into that of the second stage gradually.

Pathology—Second Stage—We have here motor and sensory paralysis, and due to compression of cord and nerve roots. The pains become less acute; feeling of dullness and heaviness, with diminished reflexes, anaesthesia, atrophy and paralysis of muscles; the sphincters become paralyzed, with paresis or paralysis of the muscles of the extremities.

The location of the focal point of course will make some variations in the pathology of this injury, such as the height of the girdle pain. A knowledge of spinal localization will be necessary to determine the focal point.

When the stage of acute or subacute meningitis fails of a resolution by absorption, we find symptoms characteristic of—

CHRONIC SPINAL MENINGITIS.

Pathological Anatomy—The lesions are constant, although differing widely in intensity, the changes often being microscopic only.

On opening the spinal canal the veins and capillaries are found congested and full of dark-colored blood. The coverings of the cord are hyperaemic, thickened, opaque and adherent. The thickening may be so great as to resemble cartilage, involving the cord and nerve roots in some degree by compression. The amount of spinal fluid is greatly above the normal. Besides the degenerative changes as a result of the compression, the processes from the pia are found thickened and swollen, and a true sclerosis of the nerve elements in the white tracts, sometimes extending into the gray substance, making a true atrophy of the cord. The nerve roots themselves are usually compressed, atrophied and degenerated, extending to the peripheral nerves and muscles, followed, as sequelae, by cystitis and bedsores.

Pathology—The symptoms are similar to the acute form, but slower. The first symptoms complained of are pain and weight in limbs, and increasing stiffness of back. Pain not very severe; not increased by pressure, but by motion, as a symptom by itself simulating that of extra spinal strain as noticed by Page in several reported cases in recent (1890) article in Wood's Monographs. Extremities heavy and weak, with prickly, tingling sensations and numbness, more marked in lower extremities; motor irritation is less than the sensory; reflexes are diminished or absent, and electrical irritability lessened or lost. Later parasthesia gives way to anaesthesia, paralysis and atrophy come on, complete as to bladder and rectum, followed by cystitis, bedsores and death from exhaustion.

MYELITIS.

A frequent result of spinal injuries is a myelitis even without fracture or dislocation of vertebrae, especially a compression myelitis from hemorrhage, the myelitis in such cases, however, being usually subacute or chronic. An acute myelitis as the result of a railway trauma would be more likely to be produced by fracture or fracture-dislocation, and not from a lighter injury. I shall therefore present only the chronic form.

Pathology—Varies with the location of the focal point. It is more or less that of an acute attack, except there is an absence of hyperaemia, and the development more gradual. We find hyperaesthesia, numbness, formication, with a steadily increasing weakness in the lower limbs. Later on comes imperfect bladder and rectal function. Whenever the anterior cornua become involved we have rapid wasting of muscles, and later the "reaction of degeneration" shows itself in the several segmental distributions, such as interference with respiration, and asphyxia if the phrenics become involved. Delayed sensation may come in as a symptom when the posterior roots become sclerosed. In chronic myelitis paraplegia is more common than unilateral paralysis, and if lateral columns become involved we have the characteristic gait (hopping, etc.) of a spastic paralysis. There are also present contractures, muscular spasms and exaggeration of tendon reflexes, and occasionally bulbar symptoms.

Pathological Anatomy—The post-mortem appearances of the above conditions are, in the diseased portion, an abnormal firmness of the cord to the feel, and the naked eye it appears flattened and depressed. Sections in my possession show this very sharply. The pia is found adherent and thickened; dura also thickened; in some cases a softening is observed, while in others, cavities (a syringo-myelia). Microscopic examination will show a marked increase in neuroglia, thickening of the coats of the vessels, enlarged axis cylinders and granulo-fatty cells.

Chronic myelitis is usually bilateral, the tendency being to spread from a unilateral transversely. The ganglion cells contain an increased amount of pigment, are diminished in size, often destitute of processes, and many of them are converted into shapeless masses with no suggestion of definite structure.

HEMORRHAGES WITHIN SPINAL CANAL—MENINGEAL AND HEMATOMYELIA—SPINAL APOPLEXY.

Although much less frequent, hemorrhage may occur in the cord, as well as into the cranial cavity, from blows, or other injury of sufficient force to break the vessels. Post-mortems have developed the fact that it is frequently the clearly defined cause of localized pathological conditions following an accident and during life. The symptoms vary with the location of the clot, as it is essentially a focal lesion, and, although the hemorrhage may extend up and down the cord, especially in a meningeal hemorrhage, it is usually limited to a few segments. Page contends that in a great many cases of the concussion of the cord of Erichson, there is a definite hemorrhage; and his conclusions of a few years ago have been amply sustained by recent pathological research. Thorburn claims that it is a lesion readily brought about by a bend of the spinal column, or a slip of the vertebra, and recoil. It may also follow an acute inflammation as a result of trauma to the meninges.

The hemorrhage may be extra dural, but of sufficient quantity to produce compression symptoms. The hemorrhage may also be into any of the meningeal spaces or into the substance of the cord itself. (Hemato-myelia.) Thorburn (*A Contribution to the Surgery of the Spinal Cord*, p. 63), says "A cause of the comparative neglect of hemato-myelia as a result of injuries to the spine is the relative infrequency of post-mortem examinations to verify the condition. These cases are not nearly so fatal as fractures and dislocations, and their true pathology is not generally recognized." "Under these circumstances," he says, "the only possible means of diagnosis is the demonstration that all the symptoms may be due to a single focus of injury; but where such a demonstration is practicable a diagnosis of hemorrhage should always be preferred to the vague and unsatisfactory designation of 'concussion of the spine.'" Mr. Page suggests that the symptoms which are attributed to concussion might have been due to a gross lesion caused by a bending of the spine.

Pathology.—The symptoms produced by a hemorrhage into the spinal canal may be either destroying or compressing, the former fatal, the latter usually more or less temporary. As the result of an unabsorbed destroying blood clot, or one so extensive as to lacerate the cord, we have an atrophic paralysis, with persistent anaesthesia, in the distribution of some of the nerves. A compression will cause more or less anaesthesia and paralysis below its level, with retention of urine and feces, priapism and pupil contraction, symptoms which subside as the clot is absorbed. A compression myelitis may be developed.

The character of the attack will depend upon the rapidity of the hemorrhage and its quantity. There is no fever at outset. In a hemato-myelia there may be paralysis as a mono—hemi—or paraplegia, with sensory disturbances of anaesthesia, hyperaesthesia, parasthesia and analgesia. The reflexes may be abolished or exaggerated.

Pathological Anatomy.—Intra-medullary hemorrhages have frequently been found as a result of a trauma to the spine, the clot being usually small in size. Blood may escape through the pia into subarachnoid space. A recent clot will be red or blackish red, older clots brown or yellow. After a lapse of some time the clot may be found encapsuled, or nothing but a cyst be found. A clot will push the nerve elements of the cord upwards, downwards and laterally. In making sections of the cord in such lesions the possible changes produced upon the cord by its removal and manipulation must be kept in mind.

In the *New York Medical Journal* for Sept. 14, Oct. 1 and 5, 1892, is a very exhaustive discussion of the possible injuries, or artifacts, as called by the author, Dr. Ira Von Giesen, of New York.

The focal nature of these traumatic hemorrhages makes necessary a thorough knowledge of the anatomy and physiology of the cord. The close relation of the meningo-rachidean veins to the ligamenta subflava makes laceration of the ligament a very probable cause of rupture of the veins, and extravasation of blood into the spinal canal, which may cause impairment of function at once, with subsequent inflammation and degeneration.

Consequent upon the pathological conditions above mentioned may come degenerative changes of the several tracts of the cord, as also of the gray matter and ganglion cells of the anterior cornua.

It seems to me proper to present these conditions, since a large majority of the true injuries of the cord, not immediately fatal, degenerate into

more or less well-defined lesions like those of disease, such, for instance, as polio-myelitis anterior, locomotor ataxia and sclerosis of motor tracts. The pathology of these lesions is not wholly dissimilar from that of diseases of the cord, especially so in tabes dorsalis. Page holds that these changes are not likely after traumas, while Gower thinks they might result from the whole cord being first involved, and every part returning to its normal state, except certain anatomical tracts, as the posterior columns. Syphilis may be back of these cases.

Dr. Edmund Andrews says: (*Ref. Handbook*, vol. VI, p. 362), "In place of the term 'concussion of the spine,' it will be better, as far as possible, to use more definite terms. This we can do now with considerable certainty when speaking of many of the morbid conditions which result from injuries of the cord and its coverings." The first of these degenerations to consider is that of sclerosis of the posterior columns, tabes spinalis, or the more common, but less correct, name, locomotor ataxia.

LOCOMOTOR ATAXIA (TABES DORSALIS.)

Is, as a disease, a common chronic affection. It may also develop as the result of a trauma to the spine.

Pathology.—Imperfect use of the upper extremities, difficulty in walking, defects in vision and disturbances of sensory nerves. No actual loss of muscular power, but imperfect co-ordination suggests paralysis to the patient.

In the first stages we have cutaneous hyperaesthesia in regions whose distribution is influenced by the trauma. Spinal reflexes are abolished. Sharp, boring pains, likened by some to electric shocks, and often so severe as to lead patient to commit suicide. After cessation or subsidence of the pain, there is hypertenderness over the place. The pains are unlike neuralgia, as they do not follow nerve trunks, but are commonly referred to deeper structures, as the bladder or rectum. As the disease progresses anaesthesia to touch, pain and temperature are more or less developed, with other peculiar sensations, as if the feet were on wool, sitting on ice, etc. Another symptom of great value clinically is that of delayed sensation, coming on when the sclerosis of Burdach's column has gone sufficiently far to interfere with but not entirely interrupt sensory impulses. From the time of the production of a sensation upon the tactile corpuscles to the time of its perception by the cortex there is a visible interval of time, sometimes as long as ten seconds. After a lapse of months or years another pathological symptom of diagnostic value is that of inco-ordination. The co-ordinating sensory tracts which cause segmental harmony in muscular motor impulses become involved in the sclerosis, and we have the gait and other movements so characteristic of such patients. The hand cannot be carried accurately to a desired point, nor can the feet be placed regularly or with uniformity. This is not the dragging, scraping gait of anterior sclerosis, for there is no want of motor impulse to the muscle, or lack of development in it, but a failure to produce harmonious movement in the several muscles required to accomplish a desired act. There is a sense of insecurity in standing or walking, especially with the eyes closed, as the patient finds it necessary to widen his base of support, to keep his eyes to the ground in walking, and generally to use one or two canes. The heel touches the ground before the toes and the movement is jerky. The

celio-spinal center becomes involved, and the pupils do not normally respond to light. Spinal reflexes are altered or abolished; the plantar reflexes gone. Later the bladder shows pain, hasty urination, paresis, cystitis and incontinence. Constipation is present as a result of diminished rectal reflex; the sexual appetite and power is lost. In the earlier stages there may be ptosis, strabismus, atrophy of the optic nerve and double vision. Charcot's disease, enlargement of joints, is one of the later symptoms.

Pathological Anatomy.—The changes which bring about the above conditions are confined almost exclusively to the posterior columns of the cord. To the naked eye a section of the columns of Goll and Burdach may appear normal. The microscope will show marked changes. The cord appears more flattened and narrower. The pia mater over the diseased portion may be thicker and adherent to the cord, as well as sometimes to the dura, and the posterior nerve roots are more or less atrophied as far as the ganglia. In some cases sclerotic changes have been observed in a few of the cerebral nerves, occasionally those of the eye, as evidenced by abnormal pupils and fundi.

A section of the diseased column shows an increase of connective tissue, with a diminution in number of nerve fibers, and with thickened capillary walls, especially an enlargement of the lumen of the posterior spinal artery. Complete organization of connective tissue results in an atrophy of the normal elements of the cord. The causes of this increase of connective tissue are claimed by Porter to be due to changes in the walls of the vessels supplying blood to the cord. Porter says: "A noticeable feature of all the cases examined was a marked change in the posterior spinal artery. In every instance its coats were thickened and its lumen expanded. On the other hand, the vessels of the anterior portion of the meninges were thickened and the lumen contracted." He argues from this that the continued slowing of the current in the posterior spinal artery favors hyperplasia of connective tissue. Any trauma which exerts an influence in making the cord circulation abnormal would tend to produce sclerosis of the posterior columns by reason of this anatomical arrangement. Syphilis is frequently behind traumatism in the production of these lesions. From a trauma this condition would probably be due rather to an interference with conduction of sensory impulses primarily, and, as a secondary step, connective tissue increase from abnormal arterial circulation, bringing about a progressive atrophy.

ANTERO AND ANTERO-LATERAL SCLEROSIS.

The disease affecting the columns of Goll about the anterior median fissure, and of the crossed pyramidal tracts, is called sclerosis of the motor columns, or antero-lateral sclerosis. Sclerosis of the anterior cornua is known as "polio-myelitis anterior," and will be mentioned subsequently.

The sclerosis of the tissue of these columns differs not from sclerosis of similar nervous elements in cerebral tissue. It develops two sets of symptoms, known as primary and secondary degeneration, the pathology of each differing only in degree.

Pathology.—At first a feeling of weakness in the lower extremities, a sense of fatigue upon exertion, slight paresis, possibly a paralysis followed

by spasms, tonic or clonic, of the muscles, and coming on chiefly after fatigue. Later comes on muscular rigidity and contractures, antagonizing every effort of the patient, and often to such an extent as to prohibit all motion. The limbs are extended at the knees, the feet assume the position of equino-varus, the thighs pressed together by the action of the adductors. The deep reflexes are greatly exaggerated, and frequently those reflexes which cannot be elicited in health respond, such as those of the hamstring muscles. Ankle clonus is particularly distressing, and is brought about as soon as the weight of the body is being brought forward upon the toes. The gait is characteristic, the feet sweep the floor with a scraping sound, and in order to facilitate the movement the foot is thrown out in a circular sweep by help of an elevated hip and rotation. There is no muscular atrophy, except from disuse. Sensation is preserved, pain is not common, and there is but little numbness and tingling; the knees tend to get locked together, because the tendency of the foot is to cross the line of direction of the body. The action is somewhat similar to that of stringhalt in the horse. The back is frequently arched, and the chest thrown forward.

The secondary degeneration, known as descending spinal sclerosis, differs only in degree from the above symptoms, paresis generally passing into paralysis.

If the injury to the cord is transverse these symptoms will be bilateral. If they result from cerebral cortical functional disturbance, the symptoms may be unilateral.

POLIO-MYELITIS ANTERIOR.

The anterior horns of the gray matter contain the giant motor cells from which pass out motor fibers, which are under control of sensory fibers through posterior roots, or the motor or inhibitory fibers of anterior columns. These may be functionally disturbed by pressure, or permanently destroyed, and undergoing degeneration. This localized pathological condition is known as polio-myelitis anterior, and may be present as a local disturbance confined to one or more segments, and as a result of a hematomyelia. Tables prepared to show segmental distribution of fibers from the anterior cornua and the sensory fibers originating these impulses are to be found in articles upon the spinal "focal" lesion, and to them for localization reference may be made. The symptoms are those confined strictly to muscular action, and possibly to trophic distribution.

TRAUMATIC NEUROSES.

In view of recent literature upon this subject of spinal injuries from railway accidents, and the rapidly accumulating evidence in clinical histories and autopsies in support of the argument that a large percentage of the so-called "spinal concussion" cases are injuries of the cortex and not of the spinal cord, I beg, in concluding, your indulgence for a short review of this condition.

Authorities of late in writing upon the results of general nervous shock tend to the opinion that the pathology of these lesions ultimately resolves itself as to localization in the cells of the cerebrum.

In *Wood's Monographs*, Vol. 10, No. 1, 1889, is a very exhaustive paper upon "Railway Injuries, with Especial Reference to Those of the Back and

Nervous System, Etc.," by Page. He divides his article into the neurosis of "General Nervous Shock" and the "Fright Neurosis." (Traumatic Hysteria, Neurasthenia, etc.)

Mr. Thorburn classifies these functional neuroses into—

First—Acute Effects. (a) General nervous depression, shock, collapse. (b) A more localized and defined disturbance of cerebral origin; "Acute Hysteria," or "Hysterics."

Second—Chronic After Effects. (a) General nervous depression, "Neutex." "Chronic Hysteria."

Mr. Page says: "It is by no means uncommon in my experience for the two states, hysteria and neurasthenia, to go together, both being originated by the same cause; but if there should be a tendency to hysteria the state of general nervous depression is clearly one likely to develop and maintain the purely hysterical disorder."

Thorburn writes, p. 185: "The symptoms of neurasthenia arise from a general defect in nutrition and action of the nervous system, and when they follow an injury are chiefly characterized by general debility, confusion of thought, loss of memory, disturbed sleep, mental imbecility, headaches (usually posterior), interference with visual accommodation, photophobia, palpitation, frequency of pulse, dyspeptic troubles, sweating, a concentrated urine, etc." "This," he adds, "is a clinical picture which, with slight variations, constantly presents itself, especially after railway injuries."

Oppenheim says that the functional cause of these neuroses does not consist in gross alterations, or even discoverable by the microscope, but in functional disturbances which very probably have their seat in the cerebral cortex.

Prof. Charcot has demonstrated to his own satisfaction that all of the motor, sensory and other symptoms of "concussion of the spine" can be produced upon persons under the hypnotic influence, either by suggestion or auto-suggestion, either by making a sensory impression upon some portion of the body as a suggestion to the cerebral cortex, or that such symptoms may be produced, when the brain is hypnotized, by the turning loose of impressions already recorded upon the cerebral cortex—auto-suggestion.

These experiments of Charcot have been so conclusive as to have satisfied other investigations that the cortex, and not the spinal cord, is the seat of very many of the symptoms as given in the "spinal" theory of Erichsen.

Recent experience has shown that "suggestion" even upon a person awake may develop all sorts of motor phenomena.

Dubois, referring to a case of spastic paraplegia appearing suddenly after a fit of anger, explains it and similar cases on the ground of rapidly passing inhibition phenomena upon the central nervous system, and that the paralysis is a pathological exaggeration of the exhaustion caused by anger. (See *Correspondenz-Blatt fuer Schweizer Aerzte*, Basel, Nov. 17, 1891.

Mr. Page suggests that the hypnotic state, as artificially produced, is similar to the mental condition produced upon a person prior to and at the time of a railway accident, where the fright of the sudden danger signal, the commotion as the result of this fright upon others, the crash, the shriek of the injured and dying, make such an impression upon the cerebral cortex as to disturb its functional acts; and that, as a result of this impression, the suggestion of injury by a slight blow upon the body, or even a slight touch, is sufficient, as a reflex, to bring about greatly exaggerated

by spasms, tonic or clonic, of the muscles, and coming on chiefly after fatigue. Later comes on muscular rigidity and contractures, antagonizing every effort of the patient, and often to such an extent as to prohibit all motion. The limbs are extended at the knees, the feet assume the position of equino-varus, the thighs pressed together by the action of the adductors. The deep reflexes are greatly exaggerated, and frequently those reflexes which cannot be elicited in health respond, such as those of the hamstring muscles. Ankle clonus is particularly distressing, and is brought about as soon as the weight of the body is being brought forward upon the toes. The gait is characteristic, the feet sweep the floor with a scraping sound, and in order to facilitate the movement the foot is thrown out in a circular sweep by help of an elevated hip and rotation. There is no muscular atrophy, except from disuse. Sensation is preserved, pain is not common, and there is but little numbness and tingling; the knees tend to get locked together, because the tendency of the foot is to cross the line of direction of the body. The action is somewhat similar to that of stringhalt in the horse. The back is frequently arched, and the chest thrown forward.

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Subsequent to that he complains of pain in his back and neck. That pain is increased two weeks later. I saw the patient three weeks after that injury and had him under my charge until he was completely paralyzed from his naval down. Now, remember, gentlemen, that the patient worked for three days after the receipt of the injury. He had no fracture of the spine. He has a sensitive place at the junction of the dorsal with the lumbar vertebrae, but nothing more than that. That patient had a form of inflammation of the cord, just at what spot I cannot say; but I do believe, as suggested in the paper just read, that it was due to hemorrhage. Why? Because that is contrary to the pathological action of hemorrhage. When is hemorrhage most destructive? Immediately after the injury and immediately after the bleeding. Take the result of hemorrhage on every organ of the body. When is it most destructive? Immediately it takes place. But here is a different condition. Two or three weeks after the injury the symptoms increase in severity. It is not the result of hemorrhage. I believe the explanation will be found in the reaction that takes place on regeneration of the injured cells. I believe that the karyo-kinetic change of the cells will be the explanation of these symptoms so long after the injury. We know that after a fracture of bone we have reaction taking place. We have multiplication of the capillaries, regeneration of the cells, karyo-kinesis going on in the bone all that time, and the point of injury is the seat of an active manifestation of tissue change. So these symptoms are not the result of hemorrhage, gentlemen. The hemorrhage is passive after it has taken place, unless that hemorrhage is infected.

The next form is the infective form. I will give you an illustration of that: One evening, returning from work, a young boy was thrown from a car and sustained no apparent injury at the time. He went home, a distance of three miles. The next day when he got up he said: "I wouldn't like to go to work to-day, mother." "Why?" "Because I don't feel well." The next morning he had a temperature of 103 degrees, which went to 105 degrees. In a couple of days he was totally blind. He subsequently died. What did he die of? The post-mortem showed suppurative meningitis, involving the cord and the cerebrum; and I believe it originated there because the first manifestation was the affection of the eyes.

I will give you another illustration, upon which I have not yet had the pleasure of making a *post-mortem*, because the patient is living. (Laughter.) He was standing on a cable car, holding on to the side, and as the train went around a curve was thrown, alighting upon the back. He got up, and complained of no injury except a sprain of the wrist. He went to work and worked for some days. He sent for me about two weeks later, or about four weeks after the injury. He was a wreck—a total wreck. He was blind; suffered from incontinence of urine. He wasn't completely paralyzed, but he was the picture of a perfect wreck. I never saw a more perfect picture of a physical wreck than that man presented. He manifested no signs of injury externally; that is, no traumatism. What was the pathology of that? Not hemorrhage; it does not act that way. I believe that man has a beginning suppurative meningitis. If not, it is the reactionary inflammation. That is, where we have a cell impaired, it must be removed; and where we have an enormous number of cells impaired, as we certainly have in concussion of the brain and cord, they must be removed. And I believe the symptoms shown in this case are due to this regenerative process. (Applause.)

Dr. Newton, Kansas City—I just want to inquire if these papers are not open for discussion. I came up here to hear these papers discussed. It occurred to me that these men with grey hairs who have had a great deal of experience could tell us much about spinal concussion. I wish to say, Mr. President, that I fully indorse everything that Dr. Murphy has said. It seems to me that this subject, which is one of great importance to the railway surgeons, is not receiving the amount of discussion that it richly deserves. There is no doubt that with the injuries that the railroad surgeon is called upon to make a diagnosis of, these very injuries that have been referred to in these papers are the ones that require care, attention and knowledge more than any others. Now, it is recognized that the great scientific classification of disease of the nervous system are impossible at the present time because so many diseases affect the different parts who have all those diseases. We can, at least, differentiate two pathological classes, viz.: organic and functional diseases. By the term "organic" we mean those diseases in which the lesion is not visible, and although we may suspect that there is a lesion; yet, so far as we can determine its presence, either with the naked eye or the microscope, it cannot be discovered. It is this class of diseases that this very subject calls for consideration, and those very cases that we, as railway surgeons, are called upon to treat. It seems to me, Mr. President, that this subject is not receiving the discussion it should from the older members of the society.

President Brock—I think the young men know more about this subject than the old ones. (Laughter.)

Dr. Entricken, Ohio—Mr. President and Gentlemen of the Convention: I have been very much interested in the paper, that is, so much of it as I have heard, for I came in a little late. I am glad to have this subject thoroughly ventilated. I shall make just a few remarks and shall not detain you long. I have been a long time in the harness, and I expect to die with my boots on, for I expect to work just as long as I am able to go, and to investigate just as long as I can find anything to investigate and have the intellect with which to investigate it. I want to call your attention to one point connected with this matter. There seems to be a point of discussion between the gentleman that read the paper and the paper with reference to what constitutes organic lesion. They say that these changes visible to the naked eye, or with the microscope, we will call organic change, and that change which is invisible may pass for a change that is not organic. I believe with the paper, that all these changes are absolute changes of cell-structure, and from investigations I have been able to make upon this subject that in all these cases, if we could examine them at the proper time, and with the microscope, we might be able to ascertain that there was some lesion. There are many things that we cannot prove by absolute demonstration which we prove to be true because they are exactly co-relative to other things which we know are true. Thus, we can often arrive at truths which we otherwise could not reach. With reference to the conditions: The injury was done, the gentleman says in the paper, and I believe it, but where do you get the proof? In one case there might be an injury and terrible results follow, and in another case there might be a more extensive lesion and less results follow. I remember holding a post-mortem upon the body of a physician who had been struck upon the head during an affray with another physician. After the receipt of the injury he went about his work for four or five days and

gradually developed symptoms of cerebral difficulty. It was a sub-acute inflammation of the membranes of the brain. What was the condition of the man at the time he received the injury? He had just recovered within less than a week from an attack of diphtheria. The system was in a condition in which, after a slight lesion, it was not possible for nature to throw out that amount of lymph about the injured structure which would enable it to make the reparative processes necessary in the neighborhood of the wound, and the result was that purulent degeneration and inflammation set up in the membranes of the brain. Take the case of inflammation of the spinal cord and we may have a slow progressive difficulty there, from a slight lesion or a small amount of clot which is only discernible with the microscope. Let us look at the condition of the individual. The man may be a diabetic or an albuminuric. He may have recently recovered from some serious damage done to his constitution from some other disease. Or he may be in that stage of chronic depletion which precedes tuberculosis, and the inflammatory exudates that are thrown out do not bring with them the reparative process which removes that diseased organic cell or gives a better cell in its place. If we view it in that light we can very easily see how it is that the difference between the gentlemen should declaim in favor of organic lesion, and in favor of functional lesions, can be reconciled. Give me the constitutional condition and I will tell you what will be the most probable result. A man comes to me with a splinter under his nail. He has neglected it until it has become an inflamed sore, and in a short time the inflammation has started up his arm. I think that any poison that could have been placed in there, be it streptococci staphylococci or any other cocci a man could name, would have been held in abeyance by plastic matter thrown about the injury had his constitution been in good condition. Investigation of the history, however, shows that he was an albuminuric and his constitution was not in good condition; therefore, the disease was not held in check. That is the point I wish to make clear in all these cases.

Dr. J. H. Murphy, St. Paul—Some three years ago, when we were in Buffalo, we requested the members present to write up something on spinal trouble, because that is something that we are more interested in as railway surgeons than almost any other subject. We are more imposed upon in that than anything else. Lawyers post themselves slightly on this subject and they are liable to ask the surgeon many questions that he cannot answer. I am very proud to know, however, that this subject has been very thoroughly investigated. You can hardly pick up a paper but what you will find a medical article on injuries of the spine. At this meeting our papers under that head have been such as would do credit to any society or any country; the American Medical Society or any other. When we can sit down and read them we will be better posted and better qualified to go into the courts than we have ever been before. I have been a railroad surgeon for some twenty-five or twenty-six years and have had a good deal of experience in that. I have had four or five cases of broken backs. When they are broken, in my opinion, they are generally gone; but in regard to this spinal concussion and everything of this description we are very blind. We have received some information on the subject and I hope it will be continued. I wish to thank the gentlemen who have done so nobly in this blind cause.

Injuries of the Cord and Its Envelopes Without Fracture of the Spine—Prognosis.

[By SURGEON ALEXANDER J. MULLEN, JR., Michigan City, Ind.]

Before I consider that part of the programme which has been allotted to my elaboration, I beg to indulge in a few suggestive remarks. The present assemblage of railway surgeons is invited to discuss "Injuries of the Cord and Its Envelopes Without Fracture of the Spine."

This subject is rather diversified and complex. If the members give their undivided attention to it, the benefit of the work will fall short of the very thing that has brought us together. As it is, the discussion will deal with topics more or less appreciated by all well-informed railway surgeons, and another subject, one in which we are all deeply interested, must, of necessity, be included. I mean, of course, traumatic nervous affections (traumatic neuroses, psychoses or hysteria—the so-called "Railway Spine").

The advocates of this lesion, among whom Oppenheim is the most emphatic spokesman, disclaim all injuries in traumatic neuroses, and consider them as the inevitable effect of violent concussions, hence, as a mere derangement of the nervous system, from the mental sphere downward to peripheral aberration.

If, therefore, we limit the proceedings to injuries, we lose the precious opportunity of exchanging valuable experience and clinical observation, of which, at least, the junior members of this organization stand in need.

Prognosis of injuries proper will be followed by that relative to the traumatic neuroses.

In the event of injury of the spinal cord or its envelopes, we must be prepared to express an opinion as to the probable duration of the case, the result, and whether or not the patient will be able to follow his vocation. The future course of the case depends upon the lesion and its pathological nature; its severity; the effects already exhibited; the celerity with which the morbid process is developing, and the direction in which it is extending; the mental temperament; the circumstances and the surroundings of the patient. When the symptoms increase rapidly, the danger of death is greater. Symptoms developing later and coming on insiduously are a well-marked sign of degeneration, and a cautious prognosis should be given. The earlier the symptoms present themselves the better is the chance for final recovery. The presence of complications bears great weight in the matter of prognosis; each case has, of course, its special complication and must be judged accordingly.

The result of treatment frequently lends assistance in prognosis. Many persons will not submit to long treatment, neither will they deny themselves sexual indulgences, nor use ordinary discretion against exposure. These, as well as mental worry, tend to make the prognosis more unfavorable.

HEMATOMYELIA.

Although the prognosis is always grave, hemorrhage into the substance of the cord is not an entirely hopeless condition. Large central hemorrhages and those at a high level are fatal. If the first few days do not bring serious complications, the prognosis is more hopeful. Complete recovery cannot be expected. Dr. Ross refers to a case of Dr. C. S. Fox, in which partial recovery took place, and cites a case of his own also terminating favorably, so far as the life of the patient was concerned, and closes by saying: "The diagnosis of spinal apoplexy in both of these cases is as certain as it ever is likely to be in the absence of a post-mortem examination." Hammond, although of the opinion that death is the invariable result of spinal hemorrhage, knew of two instances of recovery. Le Gros, Clark, Ashurst and Erichsen had cases of undoubted hemorrhage with recovery. In one case reported by Ashurst the recovery was complete after three months. Hematomyelia may be followed by acute myelitis, and all the phenomena of degeneration of the substance of the cord. The improvement which occurs at the end of the first or second week will serve to show the character of the lesion. Gray and Hirt agree that the prognosis in hemorrhage is very grave, and that death will usually ensue unless there is surgical interference. In any event, the prognosis will be the more favorable the lower the seat of the clot.

ACUTE MENINGITIS.

In meningitis following traumatism the prognosis is influenced by the general health of the patient, his age and habits; and, it must be remembered, that, in the event of the patient passing through the acute inflammatory stage in safety, serious complications of a baneful character may remain. The course of spinal meningitis is, as a rule, onward to a fatal termination, the patient dying by the gradual extension of the disease upward, by the development of some intercurrent affection, or by exhaustion.

ACUTE MYELITIS.

The higher the seat of the injury, in myelitis, the graver the prognosis as to the prolongation of life. It is much more serious than meningitis, and is seldom followed by restoration of the paralyzed limbs. The more extensive the paralysis, the worse the prognosis. It is worse in motor than in sensory paralysis, hence sensation is regained sooner than motion. It is best in dorsal and worst in cervical myelitis (Dana). The prognosis is more baneful in disseminated than in simple transverse myelitis. The risk is greater in proportion to the proximity of the lesion to the origin of the phrenic nerve, on which life depends. Any indication that foci of inflammation have developed in the medulla oblongata are of extremely grave significance. (Gowers). High fever; paralysis of the sphincters; the acute form of cystitis; the acute bed sore, and paralysis of the respiratory muscle, are highly unfavorable indications. In the event of spastic symptoms slowly developing after myelitis, they are usually associated with secondary descending degeneration, and are seldom completely recovered from (Bramwell). The slightest symptom of secondary kidney disease

increases the gravity of the case. Total absence of recovery of sensation and motion after six months is very unfavorable. Improvement may be expected up to eighteen months after the onset. In compression myelitis there is more chance of recovery, provided there is judicious surgical interference, than in other forms (Dana).

CHRONIC MYELITIS.

When the myelitis assumes a chronic form it is a very grave disease, indicative of the intractability of the morbid process, its progressive tendency, and the damage it is slowly but persistently producing. This is due either to some defect in the vascular supply or to mechanical irritation. Chronic myelitis generally progresses; and, although the prognosis is unfavorable, patients may live to twenty-five years (Dana). Those forms which come on rapidly are more likely to cease progressing. Serious involvement of the bladder is a bad sign. The more complete the paralysis the worse the prognosis. The longer the loss of sensation continues, the less likely the degree of ultimate recovery. Arrest of the disease is often obtained, but actual recovery is rare (Gowers).

In unilateral lesion of the spinal cord the majority of traumatic cases end in recovery, with proper care and treatment.

CONCUSSION OR SHOCK.

The word concussion will be used on account of its conventionality. Its pathological significance is questionable. In concussion it is possible that some lesion of the cord occurs, possibly a rupture of delicate nerve fibers, a capillary hemorrhage, or, it may be, a vasa-motor disturbance with slight serious exudation (*Am. Text Book of Surgery*, p. 556.)

Lesions that may result from concussion may be enumerated as follows: Injuries of the muscles, ligaments and peripheral nerves; locomotor ataxia; progressive muscular atrophy; tumors of the spinal cord; insanity; encephalitis; tumors of the brain; intra-cranial hemorrhage; chorea; epilepsy; neuralgia; hemorrhagic, inflammatory and degenerative diseases (Gray and Dana). Putnam furnishes evidence of shock giving rise to the impairment of the sensibility, general and special. Erichsen reports serious results to vision after concussion. Cases are prone, where they have endured for a time without improvement, to assume an irritative character, leading to difficult and sometimes dangerous forms of myelitis, with its multiform bad consequences. Tetanus sometimes follows concussion of the spine (Leyden).

Petit, Althaus, Spitzka, Gowers and Dana collected cases showing that injuries to the spine may cause a concussion of the cord, and subsequent lesions, which may become the starting point of a chronic myelitis, showing symptoms of tabes. In persons predisposed to sclerosis in general, such as the gouty, the syphilitic and the alcoholized, injuries at a distance from the cord may over-excite the cord and lead to the development of tabes. If you can get a trace of syphilis all idea of traumatism must be cast aside. In progressive atrophy following a concussion, the symptoms of impaired function creep on insiduously. Months and years often elapse before there

is actual structural disease. One of the most frequent causes of primary spastic paraplegia (primary sclerosis) is concussion of the spine. Two or three years often elapse before the fall and the first decided symptoms of the disease (Gowers). Bernhart has observed stuttering in its different forms follow concussion. Walton reports an instance where an ophthalmoscopic examination proved that atrophy of the optic nerve followed concussion. Utthoff examined two cases with Oppenheim, with the ophthalmoscope, and found an atrophic condition of the optic nerve.

Kraft-Ebing and Thomsen narrate cases of insanity traceable to concussion. The prognosis of traumatically-induced insanity is unfavorable. All writers coincide in this opinion. Where dementia follows swiftly, death does also; but other terminal dements from traumatism may linger a lifetime (Clevenger), Schlaeger, Clevenger, Spitz and Marc all agree that the patient becomes progressively demented.

Spinal irritation may last for years, but the prognosis is generally favorable. Dana says that nearly all the patients get well, but that persons with a weak will, feeble body and a neuropathic condition have the worst outlook.

In spinal congestion the prognosis is favorable, providing it is given prompt and suitable treatment. In recent cases the surgeon should allow time to elapse before expressing his prognosis.

TRAUMATIC NERVOUS AFFECTIONS.

(Traumatic Neuroses, Psychoses or Hysteria)—(The So-Called "Railway Spine.")

If the truth may be stated, the subject of traumatic neurosis is as yet, indefinite, and a bias to the profession. No evidence has, up to date, proved the exact nature of the lesion. As a scientific enigma, its solution would be affected by the incomparable diligence of professional enterprise; in fact, the lamented Watson and Schmaus (Virchow's Archives, CXXII.), with this view, have already initiated a series of experiments with animals and elicited a number of facts. Unfortunately, self-interest, hallucination and fraud have transmitted it to judicial cognizance and forced medical men into positions without actual foundation of facts.

The evidence generally adduced in proof of claims for alleged injuries sustained by railway accidents is almost exclusively of an individual character. The complaints may be real, imagined, exaggerated and even invented; and, as they are very rarely complicated by organic lesions, and their demonstrable manifestations, it is impossible for any, even the best-informed experts, to determine their existence and significance. What cannot be proved without facts cannot be denied either. There is no use of burdening one's self with judicial responsibility. The jury is equally able to judge the honesty, or the imposition of the claimant from general indications, and it is called for that very purpose. An expert who should venture to express a decided opinion on the merits or demerits of such cases without tangible evidence would invite criticism and the challenge of his honesty and professional competency. The fact cannot be denied that railway accidents are productive of deep and lasting impressions of terror upon the mind and nervous system, particularly of persons predisposed by nervous temperament, hysteric excitability or neurasthenia, thus giving rise to a traumatic neurosis more or less troublesome to the unhappy patient. But the additional aggravation in the sphere of the nervous sys-

tem does not actually disqualify the persons for their general usefulness, provided they are kept under ordinary discipline and employment. In the course of time the neurotic symptoms may be materially aggravated by other provocations.

At this point the views of the profession clash. Some maintain that the neurosis is incapable of instigating any structural lesions within the neurotic area or beyond; while others look upon neurosis as a fertile source of subsequent lesions and complications. Evidence has been advanced in support of both views.

I remember a lecture of my esteemed preceptor, Prof. Louis Bauer, of St. Louis, in which he related a case of traumatic neurosis that had existed for thirty-seven years, causing a great deal of pain and trouble to the patient. When four years old she met with a fall from a staircase, which must have made a most painful impression upon the nerves about the left hip, for the patient cried out for quite a while and excited the fear of her parents that she had suffered a fracture or dislocation. A physician was called in, made a careful examination, but detected no anatomical derangement. For a time the child recovered from the severe pains. She was soon attacked by similar pains which, however, commenced in the morning and stopped at night, not interfering with her rest or her general health. These painful attacks, in the course of time, recurred in the same way and terminated as stated. Her general health remained good; she developed as a strong and healthy person, capable of earning her own livelihood; was regularly menstruated, and had no cause to take a grain of medicine for any trouble except the pain referred to. Different physicians had successively examined the patient, agreed in the presence of hip disease, and treated her in accordance with this diagnosis. When the case came under the charge of Dr. Bauer he observed but slight attenuation of the limb and a moderate contraction of the adductor longus muscle. In consequence of this abnormal adduction, the limb was shortened four (4) centimetres, its adduction being only resisted by the shortened adductor muscle. When a careful exploration of the pelvic cavity was made, the uterus was found unusually tender, and equally sensitive was the touch in the direction of the left obturator nerve. The division of the shortened muscle and the application of the negative electrode of a galvanic battery re-established, within a small fraction, the full length of the limb and protected the patient against the recurrence of those painful diurnal paroxysms. This case, in my opinion, bears great weight, as a direct setoff to the assertion that traumatic neurosis necessarily, usually, or occasionally, may lead to structural complications.

I believe that the same accident that produces neurosis may likewise provoke some other and serious injuries to the parts involved, which would promptly manifest themselves by tangible symptoms. If, in the case referred to, some symptoms developed in the course of time, bearing slight similarity to those met with in coxitis, they were exclusively due to reflex action within the nervous sphere, none of the symptoms originating in the structural deterioration of the hip joint. In part they may have been the sequellae of habit, or lessened use of the affected extremity.

In order to give an accurate prognosis, it is necessary to consider certain conditions which will influence the duration of traumatic neurosis. Thus, in the male, the symptoms, although less readily produced, appear to be more fixed than in the female (Charcot). A neurotic tendency, whether inherited or acquired; chronic alcoholism; fluctuation in the symp-

toms—all serve to make the prognosis worse. The disastrous consequences of legal effects are well known. Thorburn thinks if there be no pecuniary complication, and if the case be at once placed under proper treatment, we may apparently expect perfect recovery within a few weeks. If, again, the case be neglected, but the financial difficulty be still excluded, the symptoms appear to be more fixed, and a longer period may be required for an absolute cure. On the other hand, Knapp says of the various functional symptoms following traumatism, "that the prognosis of these conditions is grave; that improvement is not uncommon, but complete recovery is rare." Frequent repetition of his symptoms and subjugating the patient to repeated examinations, render the prognosis of compensation cases more grave. The prognosis of traumatic neurosis is materially affected by the termination of the trial. Oppenheim explains: "By the patient being relieved of the restlessness of mind," or, as we think, by the patient getting the prize for which the excitation was gotten up.

The following, from Clevenger's grand work, gives Oppenheim, on prognosis, in full: "In but few cases does the ailment fully develope soon or immediately after the injury; usually a few months elapse before this takes place. Primarily, pains, paraesthesia and mental aberrations appear, and, in the course of weeks or months, motor and spastic derangements follow. Disturbed speech or epileptic attacks are still longer in appearing. In rare instances there may be a sudden advent of the disorder about the time of the injury, but in these cases swift recovery ensues. Ordinarily, after progressing to a certain stage, the derangements are stable, though some symptoms may cease and others become more pronounced. The mental alteration is usually obstinate, and differs in this respect from hysterical states, which are changeable, intermittent or capricious.

"As regards life, the prognosis is favorable; exceptions occur when nervous heart disturbances proceed to organic affections. A danger to life exists in an inclination to suicide through mind derangement, but this is seldom realized. Complete recovery seldom takes place. Even Page (*Medical Times and Gazette*, 1, 1885,) admits this, for in most of his cases he notices a diseased irritability remaining, which marks the person as a 'damaged man.' At all times these patients are liable to develope a severe hallucinatory bewilderment, or insanity—a transformation which we have several times had an opportunity to witness. Of dubious prognosis are such cases in which epilepsy or dementia is included in the symptoms, as well as where those decided cardiac troubles are present. Not uncommonly special regime produces a betterment in some cases, but it is especially observable that those who are involved in legal proceedings are retarded in their recovery; and this is complication to be considered. Often the interest in an expected verdict causes the patient not to desire recovery until his suit is decided. The patient thinks it is to his interest to exaggerate the subjective difficulties and to simulate. The law proceedings weigh heavily upon the individual and affect him because he is mentally altered. So we often see an improvement in their mental symptoms after a favorable issue, but, in my experience, the greater have, after the termination of the legal quarrel, remained unchanged in their ailments by the event."

That a patient, afflicted with traumatic neurosis, has lost his life thereby, is certainly in doubt, but still the possibility of such an eventuality must be considered in giving a prognosis. Dr. Lockhart Clark says that he knew of one case of a post-mortem examination of the spinal cord of a person who actually died from the effects of concussion of the spine

from a railway injury. Page reports a case of death ensuing as a consequence of uncomplicated nervous exhaustion following a railway accident. The accident was regarded as the unquestionable cause of death. There was no evidence before or after death of any physical injury. Thorburn reports the death of an unmarried girl, twenty-four years old, following an injury received in a slight railway collision. The case was seen by Drs. Thorburn, Ross and Dreschfeld, not one of whom regarded it as a serious one. Hysterical hemi-anaesthesia and retention of urine was soon followed by vomiting, cystitis, exhaustion and death. There was no post-mortem examination, but in the absence of any gross lesion, a point upon which all who saw her were agreed, it would appear that this was a case of death from exhaustion, due to hysteria, with persistent vomiting and cystitis from retention of urine.

In conclusion I wish to say that it was with a feeling of hesitancy that I assumed the task allotted to our learned and respected member, Dr. Samuel S. Thorn, of Toledo, for I keenly appreciated the loss to this association in not securing a paper from his bright and scholarly mind.

Injuries of the Cord and Its Envelopes Without Fracture of the Spine—Treatment.

[By SURGEON W. B. OUTTEN, St. Louis, Mo.]

While general nervous shocks, fright neuroses, seem generally to be connected with the victims of railway accidents, still it is now plainly indicated by all competent authority that the same symptom group may be produced by any form of injury having in its infliction the elements of shock and fright. We use the term traumatic neuroses as comprehending railway brain, railway spine, spinal concussion and cerebro-spinal concussion; all functional or supposed functional diseased conditions of the nervous system resulting from traumatism. In the study of traumatic neuroses, tracing its evolution from its first description up to the present time, no elements will impress the neurological student more than the diversity of theories presented; their wide range of interpretation, their multiplicity of symptomatology, incongruities of description, lack of definite detail, their subjectivity, presenting in their involvement vagaries difficult of comprehension and seemingly full of contradiction, naturally a cause is sought from the time Erichsen first described this condition. Up to the present time the semiology of no diseased condition presents more varied phases, characters, and still a symmetrical whole, than traumatic neurosis; extended discussion, patient, unusual research, unrestrained industrious consideration of minutiae has lent much, but not complete, elucidation. Day by day the subject grows in complexity, so much so as to relegate it almost entirely into the field of neurology, until now the average medical mind will find it difficult to comprehend unless special preparation shall be indulged in. Its history certainly presents anomalies according to its locality, so much so that a thought is suggested that the modern theorists have, by suggestion and hypnosis, made manifest upon their patients the peculiar phases

of their theories. We believe that suggestion and hypnosis have added, and will continue to add, myriads of cases of traumatic neuroses, and we believe at times predicated upon cases where trauma never existed. Starting out with Erichsen, who believed that, in consequence of traumatism, organic lesions of the brain and cord were produced—a chronic meningomyelitic trouble—his followers believing in various gradations, Lyden upholding that concussion causes frequently material lesions; Benedict asserting that traumatism causes to be separated the loose cellular tissue of the nervous system by mechanical concussion, and resulting from this circulatory troubles, nutritive disturbances, degenerations of the nerve tissues, and alteration in tissue and small vessels. Charcot, Page of England, Walton, and Putnam of this country, ascribing to hysteria provoked by the accident the consequent nervous troubles, Charcot particularly showing that paralysis contractions and anaesthesias, hyperaesthesia, convulsive crises, are of a hysterical nature. Charcot, Dunin, DuBois and others aver that trauma produces a condition similar to hypnosis, and that in that condition the neuroses originates through auto-suggestion. In terse, the theorists of this school believe that certain nervous troubles arising from traumatism are of a hysterical nature; that the neurasthenic symptoms are secondary to the hysterical, and propose the name of hysteroneurasthenia. Finally, the theory of the German school, Oppenheim, Thomsen, Westphal and others, asserting that traumatic neuroses differ from hysteria by its fixed tenacity, its combinations of mental types bordering on melancholia, hypochondrias, and more of a neurasthenic type than the hysterical as asserted by Grasset, "A neuroses general—more especially cerebral—approaches, but is still separate from hysteria. Hysteria manifests numerous local phenomena, as anaesthesia, paralysis, contractions, etc., but it does not appear to agree as regards the depression and sadness so frequent among victims of railroad accidents, and which enter so easily into the scope of neurasthenia." It is hardly necessary to give any fuller detail regarding other theories than what we have already done, but the diversity is apparent that the types of this trouble differ not only in Germany and France, but, we believe, in England and America as well. Certain it is that the assertion that modifying influences arise from nationality seems to be suggestive, if not vindictive. Thus we see that the French are of decided neurotic tendency, and that traumatic neuroses among them would be pre-eminently of a hysterical type; while the German is less neurotic and of lymphatic tendencies, the neurasthenic type seems to naturally follow. Gray, in discussing hysteria, pointing out the diversity and difference of symptoms as claimed by the French school and as found by himself, says: "It is possible, however, that too little account has been taken of the inherent differences that there are between the Latin and the Anglo-Saxon and the race that is growing up in this country, from a larger fusion of different nationalities than has ever taken place before in the recorded history of the world." Thus we find Clevenger speaking of the legal aspects of spinal concussion, wherein he has endeavored to put into disuse the title traumatic-neuroses and replace it by what he calls Erichsen's disease, says: "S. Wier Mitchell, during the late war, made extensive researches with regard to direct injuries to the nerves, and the traumatic neuroses described in his book differ widely from those investigated by Oppenheim." It is hardly necessary for me at this juncture to attempt to defend Mitchell. Suffice it to say that this country has not produced any more acute observer and general efficient student of nature than S. Wier Mitchell. Certain it is, we believe that he describes just

what he saw, and not what Oppenheim, Charcot and others had described. That it is a disease more plentiful where the neurologist abounds there can be no doubt; that where intelligence and numbers abound it is likewise true; but that it is a rarity in thinly settled portions of the country can be readily demonstrated by the most obtund who will investigate. Whether this arises from the poor suggestive and diagnostic skill of the medical attendant we will not presume to say. For if, as it is averred by Charcot and other neurologists, that trauma produces a condition similar to hypnosis, and that in that condition neuroses originates through auto-suggestion, the lacking element of suggestion would not be present in many cases where the condition was not known. Brunelli, of Rome, makes the observation of the great rarity of traumatic neuroses in Italy. E. C. Seguih makes the following observation regarding Brunelli's statement, and says: "This statement, if true, is extremely instructive, especially if we remember that such cases were almost unknown in Germany prior to 1870, and in France still much later. This appearance of a new disease long after its chief cause, railway injury, had been acted, is important as bearing on the question in proportion of maligners and exaggerators." From these small beginnings Germany and France stand pre-eminent as the producers in this particular medical line. The writer, after seventeen years of experience as chief surgeon of railway systems ranging from 1,300 to 7,500 miles, and being compelled to keep a record of all injuries to passengers, can show a tabulated list of 844 injuries occurring to passengers in collisions, derailments, wrecks, etc., discovers that where a derailment or collision has occurred near a populous city that traumatic neuroses increased; thus from wrecks occurring on suburban trains near prominent cities we find that out of thirty passengers injured five cases of traumatic neuroses were promptly developed, while on trains remote from populous points 814 injuries to passengers developed but six cases of so-called traumatic neuroses, two of which were undoubted types of malignering. Thus it will be seen that nearly one-sixth of the injuries occurring near the large cities strangely acquired traumatic neuroses, while on trains remote from populous points 814 injuries to passengers developed only six cases of traumatic neuroses, a little less than one in every 139. Thus, for instance, forty-two Italian emigrants were injured in the same wreck near a populous city while traveling in box cars, and no sign of a case of traumatic neuroses occurred, probably because none were competent to speak the English language and receive the proper suggestion. Again, out of 18,275 injured employes tabulated, only eight were accredited with having anything like traumatic neuroses, four of which resumed labor, while 767 injuries to the back were recorded, combining sprains, contusions and concussions. Now, then, let us make a comparative difference: Thus we find with all of the adverse conditions herein mentioned that only one in 2,248 3-8 amongst injuries to the employes were accredited with having traumatic neuroses, while in passengers, 844 in number, and eleven were affected, or one in 76 8-11. Out of the 18,275 injured employes almost the entire number were treated in hospital, so that observation and espionage were constant, suggestion and legal interference prevented, and there can be no imputation regarding imperfect observation, as surgeons in railway work are naturally on the "qui vive" for this character of cases, aside from the fact that each day the patient remains in hospital damages are accredited to patient; besides, settlement is always made with these employes upon a basis of re-employment, so that in the event that diseased condi-

tions were to arise after employe had returned to work, certain it is they would naturally be brought to the hospital again.

Among the passengers eleven cases in 844 were observed. As they were treated by physicians in various communities, it is natural to suppose that represents their complete number, and that if any new cases appeared they certainly would be very likely to demand compensation from the company in the event any evidences pointed to the beginning elements of traumatic neuroses. Owing to the intimate relationship existing between prognosis and treatment, and as they coincidentally influence each other, this paper would be incomplete without considering to some extent prognosis. In prognosis we find the concomitant conclusions differing almost as widely as the theories of the condition. Thus Osler says: "A majority of patients with traumatic hysteria recover. In railway-cases so long as litigation is pending and the patient is in the hands of lawyers, the symptoms usual persist. I have known return to health after the persistence of the most aggravated symptoms, with complete disability of from three to five years. On the other hand, there are few cases in which the symptoms persist even after litigation has been closed. The patient goes from bad to worse, and psychoses develop, such as melancholia, dementia, or occasionally progressive paresis. And lastly, in extremely rare cases, organic lesions may develop as a sequence to traumatic neuroses." Landon Carter Gray mentions fifteen cases of recovery. Bremer admits that many cases recover. Mitchell, Freund, Putnam, Hunn, Hodges, Hoffman and others mention recovery, while from a great number of American writers recoveries are mentioned as frequent, while Oppenheim, Wolf, Knapp, Strumpel and many European authors agree in stating that most cases are incurable, using the expression of "true traumatic neuroses." It is somewhat instructive and suggestive to compare the statement made by Hodges, of this country, with that of Hoffman, of Heidelberg. Thus, in all cases of real traumatic neuroses treated by Hoffman, one was cured, one improved, and nine remained unimproved; while Hodges gives his results in twenty-one cases, showing twelve recovered, six almost cured, and three unimproved. Judd believes that seventy-five per cent of the cases recover; others in this country make equally broad assertion. Oppenheim reports thirty-two cases, no case of cure, and only six improved. Thus it will be seen that the differences certainly are erratic as regards the opinion in prognosis between this and the older countries. Probably the difference in results might be attributed to the difference of nationality equally as much as the modification of its types. Certain it is that sensible and accredited authorities mention recoveries as numerous in this country while the reverse seems to be the case, particularly in Germany. If there exists pronounced differences in the type between patients in France and Germany, why should not the patients in this country, with their multibled inherited elements, present marked differences both as regards disease and result. Interblended elements certainly stamp a fixedness of type, while an unusual mixture leaves but little chance for uniformity of type, and individual differences are greater, and we cannot think the dismal prognosis of Oppenheim and others will hold good in this country. We are absolutely sure that it does not hold good in many other diseased conditions. We must not refrain at this juncture from expressing the thought that any case of this character treated by Oppenheim and others of his deeply impressed beliefs and their intense suggestion would be Oppenheimish from the beginning, provided, of course, that the corelationship of trauma and hypnosis existed. Thus, in the matter of simulation, the percentage

in this country certainly will run, with those who have had experience, considerably over sixty per cent, while Schultz, Hoffman, in the older countries, find thirty-three per cent, Seligmueller twenty-five per cent, and Oppenheim finds less than four per cent. Out of sixty-eight cases he mentions, sixty-seven were verified by diagnosis. Many of the best authorities in America seem to be non-committal regarding data of simulation and prognosis, possibly under the influence of European literature. The treatment of traumatic neuroses present indications, seemingly, at times, almost as varied as their are individual cases, hence there has not been presented much that is concise and well rounded in treatment. A uniformity of opinion has been reached in the fact that isolation is a necessary and essential factor in the treatment of traumatic hysteria and neurasthenia, probably excepting those cases which are of melancholic tendency. A rigid, determined and well-planned course adopted, the patient should be placed under the absolute control of a physician, the complete withdrawal of patient from the harmful influence of ill-advised sympathy, aiming to obtain as near as possible absolute rest and seclusion. As E. C. Seguin so pointedly and lucidly says: "Supposing the case of a predisposed person, frightened and jarred by severe accident, who subsequently receives harmful sympathy from relatives and physician, who was made the object of multitudinous suggestions, and by physicians, lawyers and friends, whose volition and reactive power are impaired by nervines and sedatives, even without a trace of voluntary or intentional maligning, a neurotic state is developed which gets beyond—utterly beyond—the control of the patient and the influence of the treatment. The patient has lost hold of his nervous system, after the fashion of the morphinist, and cannot regain control. This, we think, explains the incurability by damages or by drugs of some cases; treatment has been imperfectly, often injuriously, attempted. In several instances the treatment has been such as to favor the development of a general neurosis in a healthy person by ill-advised sympathy and absurd precaution, by the use of bromides, chloral, alcoholic stimulants and constant fussing with the individual. Since fear, morbid self-watching, suggestion, auto-suggestion and sympathy are so well recognized as being factors exerting evil influence on traumatic and non-traumatic neuroses, separation from the family, seclusion and a strictly tonic treatment, medicinal and morally, would seem to be the fundamental parts of a rational treatment." That above all psychic rest is demanded; that the psychical condition of patient is the determining factor of the cure, and that, if the psychical condition can be controlled, the result will, in many instances, be all that is desired.

Landon Carter Gray says: "I firmly believe that it is the psychical element, together with the resulting lack of proper treatment, that makes the usual unfavorable prognosis in this class of case." He depicts the psychical condition in traumatic neurasthenia as being very unfortunate. No matter how uneducated the patient may be newspaper talk of everyday life has imbued their minds with a dread of the mysterious and baleful consequences that may happen to those who receive injury, particularly in railway accidents. Have heard for many years of the damages which have been paid by corporations. Once having been injured instead of indulging in judicious treatment, solicitous friends and lawyers appear upon the scene, suggestion upon suggestion, suit for damages instigated and commenced. Long, weary years of suspense, want, waiting and disappointment through laws' delays, appeal from court to court, then cost of action,

lawyers' fees and a trenchment exiguity of money, result confirmed—traumatic neurasthenia. He does not believe that cure is often possible when litigation is in progress, and says in several instances: "I have persuaded patients to promptly place themselves under treatment, and at the same time to either abandon or compromise the legal proceedings, and in every instance a cure has been effected. I have a history of fifteen such cases." As all authority plainly indicates, the mental condition is the one chief factor to treat; that improper surroundings and the use of remedies offer no chance of success; narcotics and stimulants, injudiciously given, are harmful. The element of mental worry as regards the traumatism having been settled, the treatment then is addressed entirely to the condition existing. The treatment of traumatic neurasthenia and hysteria by the S. Wier Mitchell treatment, from recent experience, is so broadly sensible and so thoroughly practical that I shall make no apology for condensing the main elements of his "rest cure," as detailed by Dr. J. K. Mitchell in Hare's Therapeutics. To one who has tried other methods in this class marvels at the progress made in some cases and the sense of efficiency and comfort in its administration. Its intense, intelligent system and studious manipulation of detail certainly stamps it as broadly utilitarian and effective. It is not our purpose to detail symptoms nor discuss deferential diagnostic elements. While believing that traumatic neurasthenia and traumatic hysteria are distinct and depending largely on radical differences, and that they may be combined, still I believe with Thorborn, "that neurasthenia is common without hysteria, and hysteria is at least not unknown without neurasthenic symptoms." Regarding the first element of treatment, namely, isolation, this is the foundation of the treatment, and the physician in attendance has to be unalterably determined. If he makes the least concession he had better not undertake the patient's cure. A plain statement made to all concerned, detailing the advantages and the results hoped to be accomplished.

In our experience in hospital, it is with extreme difficulty to keep the regular, systematic work of the institution from interfering with the proper treatment. Thus, as stated by Mitchell, J. K.: "Not all cases of neurasthenia or hysteria are suitable for it. While we have other means at our disposal, it would be most unwise to order without discrimination all nervous patients into bed—to force upon them a life which involves separation from their friends, the entire attention of one or more attendants, and consequence great expense. It is only when other ways have failed to cure that we should use the "rest treatment." If the nervous prostration be complicated with melancholia the "rest cure" almost never does good. The habit of too minute analysis of their own symptoms of microscopic investigation of their moral and mental condition, to which sufferers of melancholia are prone, is only fostered by the opportunity afforded by confinement in bed, and consequent inaction. If to melancholia a suicidal mania be added, it is especially undesirable. The depression increases, the loss of appetite usually grows greater, and the case grows worse—not better. For such cases active exercise is preferable to the passive movements of massage, and open air and movement are better tonics than those of the apothecary." Isolation assured, then comes the selection of a nurse, a young, enthusiastic, intelligent woman. A male patient, as a general thing, obeys their mandate better than one of the opposite sex, and besides, heredity sustains it. She must be in thorough accord with her medical attendant, obeying each mandate issued punctiliously. If patient does not well it is proper to talk to patient about nurse in her absence, determin-

ing if adverse causes exist, and if sufficient cause exists, remove nurse. If nurse is accomplished to read and write, it is better so as to interest patient in little things as patient gets better. Isolation in the treatment of these cases cannot be measured in time, but be measured by result. Rest as an element of treatment depends upon the severity of the case. In extreme cases, patients are forbidden to feed themselves or to turn in bed, especially in cases of exhaustion of cerebral and spinal centers. When decided improvement takes place, allow patient to sit up in bed at meal time. Then, as strength increases, gradually increase exercise. But insist on a daily quantum of rest for months after improvement. In considering the diet, the patient's tastes and prejudices have to be considered to a certain extent. Commencing with a table spoonful of fresh skimmed milk, four or five times a day, with light, digestible food; gradually increase milk while decreasing the food; four ounces may be given every two hours, gradually increasing to eight or ten ounces every two hours, warm or cold, as the patient desires. If milk becomes unpleasant in taste a little caramel chocolate, or a spoonful of coffee or tea can be used as flavoring. Barley water or rice may be added; peptonized milk, frothed with vichy or other carbonated water, can be used. After the first four or five days a single chop may be given at breakfast, gradually added, and by small advances patient takes three meals a day and two quarts of milk. Massage should begin within the first forty-eight hours after the patient has been put in bed. Commencing by gentle stroking of the whole body for fifteen or twenty minutes, this for the first two or three days, then deep massage of the entire body, rapidly increased in duration from an hour to an hour and a half. Abdomen thoroughly rubbed to excite peristaltic action of the bowels. Plain hand must be used in massage; unctuous substances on hands of manipulator lessens friction, robs massage of its virtue. In the application of electricity the slow, interrupted, faradic current to the muscles once a day, a rapidly interrupted current through the spinal cord, one pole at the nape of the neck, the other on the bottom of one foot, then the other. Regarding medicines, purely tonic treatment, malt extract, iron in its various forms, particularly the pyrophosphates or lactates, or carbonate of iron, as in Bland's pills, combinations of iron strychnia. Should the milk diet fail to produce sleep, hypnotics should be given, sulfonal presumably the best, small doses rapidly repeated. A wet pack may be used for the purpose of inducing sleep, a sheet wrung out of water at temperature of about ninety degrees F., then rapidly rolled in a warm blanket, left lying on the bed for a few minutes. Patient remains in pack ten or fifteen minutes, then taken out and rubbed dry, and put again in bed wrapped in blankets. When patient begins to sit up for a half hour electricity should be given two or three times a week. After ten days of sitting up electricity stops altogether. Gentle massage may be continued several weeks longer, and the milk gradually diminished. The exercise should not begin until the patient can sit up without fatigue for three-quarters of an hour. After patient is enabled to walk, riding and other open exercises indulged in. Having thus indicated the S. Wier Mitchell treatment, we still believe in studiously carrying out with patient, judicious suggestion, being perfectly sure at all times not to permit contradictions to occur. Well-timed, studious suggestion, certainly seems to me to be a most competent source of benefit. Anything which conveys with it proper suggestion ought certainly to be used. We have recently used in a case of traumatic neurosis the animal extracts as devised by Harmond, namely, cerebri and medulline. Now, while doubting that they represent either

cerebral or medullary substances of the nervous system, still these aseptic solutions convey with them the proper line of suggestion, hence we were not adverse to their use. The Cerebrine was injected hyperdermically in the morning—five minims—the Medulline in the evening, the same quantity; the patient claiming that positive benefit accrued therefrom, as he went to sleep immediately after injections, sleeping an hour or so in the morning and having a good rest a greater portion of the night. Our supply of extracts having been exhausted, we used the hypodermic injections of sterilized water, which seemingly produced equally as good effects, the patient sleeping and resting just the same as though receiving hypodermic injections of animal extracts. When patient complained of pain in any particular part, an injection was used at the point of pain. Both water and extracts seemed to be competent to dissipate pain. In cases drifting into chronic invalidism a change of air and scene, a diversion of thoughts by surroundings, nomadic life, mountain and salt air, seem especially desirable. When psychoses, progressive paresis, make themselves manifest, treatment seems to be of but little avail.

DISCUSSION ON DR. OUTTEN'S PAPER.

Dr. W. R. Nugent, Oskaloosa, Iowa—In the treatment of injuries to the cord and its envelopes, without fracture of the spine, we start first with the treatment of the stage of shock, and next the results. In the treatment of shock, treat as a severe strain. Rest—in bed, in prone, supine or sitting posture, if patient rests easier and is more comfortable. Hot formentations along spine. But get as near as possible absolute rest. If symptoms indicate stimulants give whisky and hot water to assist rest and quietude in the re-establishing of the circulation, for without rest and quiet nothing will be of any avail. Should the shock be so severe as we sometimes find it, as when the pulse and respiration are so feeble as to be almost imperceptible, with cold and clammy skin, deathlike pallor, with fractures contracted and muscular weakness almost to paralysis, hypodermic injections of stych and atropism, and surround patient with bottles filled with hot water, or use hot brick. Cover body with hot woolen blankets, or, if can be had, water bed filled with water. Dry heat is preferable. Recollect to keep a close watch on the use of stimulants, for as he who has once seen the good results will know their benefit, and as their use cannot well be avoided in severe cases of shock. If you find inaction is coming on, very little is required; but should you find the reverse to be the case and already enough has been given to see some effects produced, but none are discovered, it is probable that the stimulant has not been absorbed and continuance would only result in producing vomiting. I would then try hypodermic injections of digitalis, strychnia or atropine, one or combined, as digitalis has been tried and proved successful in many cases; so has strychnine and atropine, as their action is on the vasomotor nerves and on the blood pressure and have been tested during the continuance of shock. Digitalis, by its action over the heart and the arterioides, and especially its action over the heart in diminishing the rapidity of its contractions, and also increasing its strength, while at the same time it stimulates the muscular walls of the arterioles. Strychnine has proved its value in extreme cases of shock from various causes, and stands alongside or ahead of any remedy in all classes of cases when the shock was severe to the vasomotor

and respiratory centers in the medulla oblongata and spinal cord. The symptoms of shock are essentially paralytic in their nature and affect the nervous system as a whole. Not one center, but all the nervous centers—all the nerves—are more or less affected.

Should our efforts prove successful and the system rally from the shock, our first point is gained. Next, as far as we can, avert any sequelum, either functional or organic. To do so it is imperative we keep the patient and the surroundings quiet. Should insomnia per se be present and all efforts to procure sleep without drugs have failed, small doses of chloral hydrate in hot water, with Fl. Ext. Lupulin might be tried, but would watch the action of the chloral on the heart. Everything being quiet and pleasant will frequently do more than drugs to procure sleep. I have used hyoscyamine with best of results after trying chloral. But should insomnia be due to pain referred to spine our remedy then is morphine, as it is not only better to procure sleep, but serves to prevent the exudation of serum and consequent formation of adhesive lymph, and these, save under pressure on the cord, in the treatment of meningeal congestion, Fl. Ext. ergot in from thirty to sixty drops, given every three to four hours, is the admitted remedy; and this drug, given to full indications, has a very salutary and soothing effect on hyperemic irritation of the cord and its membranes. To control pain, morphine is the best, as, for reasons before stated, given in doses and at intervals so as to produce the desired effect, absolute rest and quietude are to be enjoined, in bed, for obvious reasons. Erichsen and others prefer the prone couch, as in the prone position the spine is higher than any other part of the body, and thereby prevents passive vassous congestion by allowing the blood vessels to be drained and other sequences resulting from a supine condition; it also allows applications to be made directly to the spine, or other treatment, as may be indicated from time to time. At the approach of the inflammatory stage vigorous measures are to be promptly employed, giving one or two doses of calomel as a purgative at the onset; local depletion along spine with cups or leeches. When the spine is overheated apply ice to inflamed surface; later on use potassium iodide in doses as demanded, in connection with counter irritation along spine, or the actual cautery if deemed indicated. If history of patient shows syphilis within two years mercury should be given. Belladonna has proven beneficial in hyperaesthesia, vessical, urethral or cutaneous. As remarks Brown-Sequard, it is the best remedy known to control reflex action of the spinal cord. In connection with above drugs, fl. ext. ergot given will be found very efficient; but rest and quietude during the whole course of treatment, as a reparative measure, is as fully important as any we have in restoring the injured cord and meninges. Anaemia of the spinal cord has long been recognized by a group of symptoms collectively known as constituting the disease called "spinal irritability," and in the great majority of cases the disease stops here—but another form in which it advances beyond the stage of irritation and enters that of paralysis. The symptoms of this last stage are those of exhaustion, associated as nervous exhaustion, and is liable to be with neuralgic pains and hyperaesthesia, which often assume such prominence as to hide the allied conditions of a paralytic character. These symptoms may develop suddenly after an injury, or they may come on very gradually, owing to condition of patient, this condition is most apt to occur in women, under thirty-five years of age, or in the young, yet may occur in men. These symptoms when patient is at rest are not much if at all com-

plained of. The pain, intense as it may be when being examined, should his mind be diverted to other matters, an examination can be made without any sign of suffering. The same with movements of the body. But in attempting to make an examination without so diverting his mind, he will cry out even before he is touched. In the more severe cases of anaemia of the cord there is paralysis to a greater or less degree, with loss of sensation and motion, most generally below a point in dorso-lumbar region; the same in receiving and transmitting impression; legs and feet are cold, with loss of reflex sensibility and motive; there is apparent almost complete exhaustion, at the same time the mind may not be affected. With all these conditions, and yet no pathological evidence of disease, as remarked by Erichsen, anaemia of the cord is rather a functional disease—a clinical expression. Possibly, more than a well-proved pathological fact, a better knowledge of the sympathetic system will probably explain the base of the clinical expressions to be a pathological one.

In the treatment of anaemia strychnia (iron, various preparations), quinine, best of food (and a full allowance), with wine or beer. Strychnine, if given and tolerated, is evidence of the use; but, should any inflammation exist, should not be used. Proper attention should be paid to the temperature of the body, to see that the extremities are kept warm, so as not to allow them to be cold. Anything that will help build up or invigorate is indicated—fresh air, rooms well ventilated, cheerful home, etc.

Dr. King—Traumatic neuroses, without a visible and appreciable traumatic lesion, is the biggest fraud of the nineteenth century. (Applause.) It has behind it greed, falsehood, perjury and avarice, and all of the mean things that can lie at the bottom of the soul of the mean, avaricious and lying man. (Applause.) I know that the neurologists, in order to account for some of the queer symptoms that are presented by people who are injured upon railways and by other corporations, and who have a status in court and are trying to get money—I say that the neurologists have spun fine theories to try to account for the theories complained of by these people; and they get up traumatic neurosis, without visible and distinguishable or appreciable traumatic lesions; in other words, they are trying to account for falsehoods and lies.

I have been in the profession, gentlemen, for nineteen years, and during that time I have honestly investigated and endeavored to get at the bottom of the conditions and symptoms presented by these people; and I have come to the conclusion, deliberately and without being hired or paid, and without getting anything for it, that when I find a man or woman (I think as much of women as anybody in the world—I even love the old ladies with warts on their noses)—(laughter) complaining of paralysis of the one side, where the limb of that side measures as much as the other; where the muscles respond to the test for the reaction of degeneration—where I find these conditions, I have come to the deliberate conclusion that that person is lying, that they know they are lying, and all they want is money. They are not under any hypnotic suggestion. That takes a walk when they get the money. We all know that when we have an injury to the spinal column and a fracture, or displacement, of the vertebrae, that we are very liable to have an injury to the spinal cord; and, when we have an injury to the spinal cord, we have an affection of the nerves that proceeds from that part of the cord, and below it we have anaesthesia, hyperaesthesia, paralysis, atrophy, and all those things.

When we have an appreciable traumatism—one that you can see and

feel—with that sort of condition pertaining to the limb, then we know we have something to deal with. But when I see a man or woman who claims to have been sitting in a railway train, and who fell forward and struck his forehead slightly on the back of the seat in front of him, which does not make a laceration of the soft parts; then, some weeks afterwards, after somebody else has been settled with, find they have loss of memory, difficulty with the eyesight, etc., then I immediately place them under suspicion. Taking it from my standpoint, I cannot understand or appreciate the object of suggestion to a man or woman that they are sick, or to make them believe that they are sick. If they are so already, why do they need any suggestion that they are hurt from some interested party? It has been suggested that you are hurt; that you have numbness in the limb, and that you should take on the conditions that should follow this kind of an injury; that you should have this or that symptom. I have had business dealings with these people, both men and women. I remember a case several years ago wherein two men claimed to have been injured. We went out to see them and they were using crutches; complained of various symptoms in the calves of the legs and in the ankles. I found their limbs symmetrical, and both had good-sized limbs for men of their weight. I made the test for degeneration and found it absent, and that there was nothing the matter with either one of them. Both were thrown out of court. They threw their crutches away and came back to work within a week. I suppose, upon fine neurological theories, somebody had suggested to these men that they were partially paralyzed in one limb. If they did think so, why didn't that impression continue after they were thrown out of court and had no chance to get money? Greed, gentlemen, and nothing else, lay at the bottom of these cases.

I saw two women, also, who claimed to have been injured. They sat up all night because they could not find accommodations in the sleeper. Both sued for \$10,000 for injury to the spine. (Laughter.) Both went on the stand and swore that they had pain in the back ever since they sat up in those cars. When asked the question, why they didn't have it when they sat up all night with the neighbors they gave very unsatisfactory replies, saying that was a very different case, etc. They were both thrown out of court. I wish now to state a case of a woman I saw some time ago. She was a little, old whippoorwill; wasn't married until she was forty-two. (Laughter.) When I called she was making grape jelly. She didn't know who I was, and was bobbing around like a popinjay in a stumpy field. (Laughter.) She hustled out to the well and got me a glass of water; I drank it and finally told her who I was. Well, what do you think? Why, that woman went to bed right in the room where I was (great laughter)—with her clothes on. (Renewed laughter.) This was another case of traumatic neurosis.

Now, what is at the bottom of this hypnotic suggestion business? Greed. Modern desire for money. Money rules the world. Men die for it. Get it by fair means, if you can; or, as the old man said to his son, "If you can't get it by fair means, get it." (Laughter.)

Another question: I have practiced medicine now so long that I am afraid to tell it, for fear people may think that I am getting old. (Laughter.)

I have waited upon people who have been injured in all sorts of ways—bumped backs and bumped heads, sprained legs and fractures—and of all the cases I have ever seen, outside of the cases where there was a possibility of getting something, I will state that I have never had one of these cases of traumatic neurosis after the traumatism got well. Nor have I

ever had any of these people under my care for long years requiring treatment by electricity, massage, etc., for a neurosis. They get well when they know there is no chance to get money. I am not willing to treat these people with courtesy, or consideration, even, for I believe in treating fraud, deceit, falsehood and perjury as it should be treated—with the contempt of every honest man who lives. (Applause.) If you have a fractured spinal column you have an appreciable lesion. I think Dr. Murphy's case, were it here to-day, was one of those cases of fracture of the base of the skull, followed by meningitis. If you have any serious trouble following an injury, paralysis, or anything of that kind, such cases, I think, are properly tested by electricity and other tests. I have never seen a case of true paralysis, partial or complete, that the paralyzed portion of the body did not get smaller and where it did not respond fully to electricity the same as it did in life.

In conclusion, I say again, that I am not willing to treat these people even with courtesy, for I believe they are liars and frauds, every one of them. (Applause.)

Dr. Murphy, Chicago—It is a painful duty which is imposed upon me, to ask you to reconsider the statements of the last speaker. There are people who are honest, and who have received injuries of the spinal cord—fatal lesions. They do not die in the hope of monetary reward. (Applause.) If they can sustain an injury that will produce death, why can they not sustain an injury that will produce minor symptoms?

I recited two cases this afternoon: one of whom fell and struck on his buttocks without fracture of the spine, and who worked three days thereafter. I do not believe that man had a fractured spine, for if he had I don't believe he could continue to carry carboys of sulphuric acid for that length of time in that condition; and I do not believe the last speaker believed it.

The next case is one I wish to refer to particularly. That is the one upon which I stated I had not had the pleasure of making a post-mortem. There was no fracture of his spine, I am satisfied. There was no fracture of the base of the skull. I have here a telegram, which I received to-day at the hotel, stating that Mr. Merrill is dead. This is the case to which I referred when I stated that I had not had the pleasure of making a post-mortem. He is dead. That man went about the streets for three weeks after his injury. He came to my office with no hope of pecuniary reward, suffering from an injury to his wrist. He came back again shortly after, complaining of pain in his back. He had all the symptoms of spinal concussion and of injury to the cerebro-spinal centers. Here are three cases in which there is no evidence of physical injury. This man had no evidence of physical injury. If we can sustain injuries which will produce death, why cannot we sustain injuries which will produce pain in the limbs, and all those other symptoms from which these poor patients suffer? In our capacity of railway surgeons we are apt to think that all of these people are imposters. I believe some of them are. Dr. King referred to the woman who went to bed in his presence. How many of you here present have seen a woman going about expecting to be delivered of a baby and no baby was there? Does that prove that she suffered no pain, or that she was not honest? No, sir. There are honest cases, and many of them.

In Dr. Outten's paper, a most excellent one, by the way, he referred to treatment. In my opinion, that is something we should earnestly consider. What are we to do for the relief of these patients? They suffer from pain during the day, and pass many sleepless nights. What are we to do in order to relieve our patients of all these symptoms which make life miserable and almost unbearable? I think this body should take up that subject in earnest. You have a patient with hysteria. It does not do to make a hasty diagnosis of hysteria and say the patient is to blame; for I believe they have a physical reason for that hysteria. Dr. Outten struck something which I think is particularly important: that we should institute such treatment as will help to restore the particular part that is suffering. If you have a fracture of the leg, and the process of regeneration which I mentioned this afternoon does not take place with sufficient rapidity, what do you do? Why, you give the salts of lime in the form of phosphorous. Then, again, if you have a case of injury to the brain—I will confine my remarks to injury of cerebro-spinal system—how will you treat it? You will put that patient at rest; and I must say that I feel guilty for allowing that man (Merrill) to go about the streets for three weeks after his injury. I feel that I am to blame, and that I might have obviated that fatal result which has taken place since I left home. I think it is our duty in concussions of the spine or brain, whether they are from railroad or other accidents, to put the patients at rest immediately.

Now, then, why do the symptoms manifest themselves later? Why do they come on six weeks later is asked? For the best reason in the world. For instance, we have an area of sloughing tissue. Why does that separate slowly? Because the power of regeneration and repair is slow, and the portion of the body will amputate itself if its vitality is dead.

Then we have our nervous symptoms manifesting themselves a long time after the injury. Why? Because reaction in nerve tissue takes place a long time after the injury. It is not because the lawyer has been called in, or that the patient has any hope of reward. It is because the nervous system regenerates itself after a long period of time, and this regenerative action takes place at that long period of time after the receipt of the injury. (Applause.)

Dr. King—How about those cases where the symptoms go on until after settlement, when they so suddenly recover? What takes place then.

Dr. Murphy—I will give you the explanation of Beach upon that. Beach believes that the settlement of the question is prompt treatment for this class of cases, for physiological reasons.

Dr. C. B. Stemen, Ft. Wayne, Indiana—I think the two last speakers are both a little radical. We have certainly had most excellent papers upon this subject, covering the history, anatomy, physiology, diagnosis, prognosis and treatment, and we cannot fail to profit by them. My judgment is that if we could have examined the cases of Dr. Murphy we would have found a tubercular or syphilitic cachexia; because no traumatic neurosis would develop such a history as given in his cases (at least, not in my experience), unless there was some constitutional contamination. And it is reasonable to suppose that in the history of the cases which he has given to-day, that there has been some constitutional contamination.

In regard to the cases of Dr. King, I think he is a little radical, also, in regard to saying that we find no cases of "railway spine" in patients who have been injured in a railway collision; that there is no traumatic neurosis; because all of us have had cases in whom these symptoms appeared,

indicating that some injury has existed. Certain papers which have been read upon this subject have explained these phenomena, and I think this association is greatly indebted to those gentlemen for the great labor of investigation and preparation that they have gone to upon this subject, and to present to us for our education. (Applause.)

Dr. Emory Lanphear, Kansas City, Mo.—Mr. President, Ladies and Gentlemen: I wish to compliment Dr. Outten on the excellence of his paper in general, but at the same time to criticize as strongly as language will permit certain things contained in its pages. I also wish to thank my distinguished friend, Dr. Murphy, of Chicago, for the careful and thorough manner in which he has sustained the position that in the present state of our knowledge of spinal diseases there are certain cases which we must classify under the name "traumatic neurosis," and which include patients who are certainly not maligners. For a number of years I have been closely studying the subject of injuries to the brain and spinal cord; in this study it has been my pleasure to examine many people who claimed to be injured and who were engaged in litigation for the recovery of damages. Many of these were imposters, as Dr. King so graphically explains, but I am sure a number were perfectly innocent of any intention to defraud, and some were permanently injured. But some very pronounced cases have been in patients who had no incentive whatever to deceive—no financial benefit in view and no sympathizing friends to delude—who were as anxious to be cured as I was to relieve. These are the cases to which Dr. Outten's remarks are devoted: employes of the company who have been injured in such a manner as to give rise to certain symptoms which have been classed under the terms "spinal concussion," "traumatic neurosis," "Erichsen's disease," etc., but which are not sufficiently well defined (or well enough understood) to give us a diagnosis of some well-known disease of the spinal cord. It is greatly to be regretted that no paper in this series has been presented upon the subject of diagnosis—since we should invariably make a careful diagnosis by exclusion before instituting therapeutic measures for the relief of "spinal concussion." This expression, sir, is much like the "malaria" of the North and the "slow fever" of the South—often a mantle used to cover ignorance of the real condition present—and I hope ere long to see it eliminated from our list of diseases. But for the present we must accept it, and before beginning our treatment thoroughly go over the history of the case and the symptoms and eliminate other diseases. Among these I may mention: (1) Hysteria, and hysteria is now recognized when making its appearance in the male almost as readily as when developing in the female; (2) syphilis, which may have existed for long but passed unnoticed in its manifestations until after the reception of the injury; (3) sclerosis of the lateral columns of the cord, which, like the preceding condition, may have antedated the traumatism, the peculiar symptoms having escaped the notice of an ignorant or busy person until attention is directed thereto by the traumatism; (4) posterior spinal sclerosis, of which the same remark may be made; (5) hemorrhage into the spinal cord or its meninges, which I believe to be the most frequent condition present, in the cases grouped under the head of spinal concussion; (6) transverse myelitis, which I have found present in more than one case of paraplegia, diagnosed "railway spine;" (7) injuries to the cord due to fracture or dislocation or fracture of the spine; (8) various troubles of the cerebral instead of spinal origin. These are a few of the diseases which come

to my mind at the present moment which must not be confounded with "spinal concussion," because the treatment would in many instances be totally different from that which should be carried out in the latter condition. The importance of the last group—injuries to or diseases of the cerebrum—may be appreciated when I say to you that an astonishing proportion of the cases detailed by Mr. Erichsen in his much-quoted book may, by careful study, be recognized as hemorrhage from rupture of the middle meningeal artery, lesions of the motor area (like tumors, abscesses, etc), hemorrhage from some branch of the lenticulo-striate artery, cerebral meningitis, and so on; and by thorough sifting we conclude that not one-fifth of all his cases can be regarded as traumatic neurosis. Such are the advances in cerebral and spinal localization and in our knowledge of pathology that I make this statement with due deliberation, and stand ready to defend my position. Above all, of course, we must exclude maligning before beginning our various lines of treatment. Having determined, then, to our satisfaction, that we have to deal with a case of "spinal concussion," what must we do to cure our patient? The essayist has covered the ground pretty thoroughly, but has not been quite explicit enough in certain particulars. I would classify remedial measures under the heads:

First—Internal medication.

Second—Electrical applications and massage.

Third—Hypnotic suggestion.

Fourth—Surgical measures.

First—Internal medication must be governed by the character of the morbid manifestations. All the symptoms met in this disease must proceed from one of two conditions, viz.: anaemia of the spinal cord or its enveloping membranes, or hyperaemia of the same structures. If it be decided that the phenomena present in a case depend upon a hyperaemic state of the spinal cord, there are three remedies upon which we may depend. These are ergot in full doses, the bromides in large quantities, and belladonna pushed to the full physiological limit. If, upon the contrary, the symptoms are decided to be due to an anaemic condition of the cord, an opposite line of agents must be employed, consisting of arsenic—on which I place great confidence when given with the compound syrup of hypophosphites—iron and sulphate of strychnine. These, then, comprise the remedies upon which we rely in the management of these cases. As to the use of cerebrine, mentioned in the paper, I wish, with all due deference to the opinion of Dr. Outten, to most emphatically condemn its administration in this, as in all other diseases. It has no scientific basis; we should, in every remedy we use, be able to explain, upon well-known principles, the way in which our results are attained, but in the case of cerebrine, testiculine, ovarine, spinal-cordine, and all the other "ines" of similar character, we have neither chemical nor physiological reasons for their use. From experiments upon animals made by myself and others, I am convinced that all the good results obtained from the injection of such drugs may be observed from a similar use of pure blood serum, or of Brown-Sequard's testicular juice; and I believe that the time will soon come when the physicians who are now so enthusiastic in their chase of this, the latest ignis fatuus of medicine, will be as loth to acknowledge their temporary—I almost said imbecility—delusion as are those who went wild over Koch's lymph.

Second—Of the use of massage I can only say that in cases where atrophy is conspicuous it must of necessity be of great value. Particularly

is this the case when employed in conjunction with the Wier Mitchell treatment of total isolation and absolute quietude.

As for electricity, in cases where the trouble is chiefly dependent upon mental derangement—the true traumatic psychosis which has been alluded to—the Faradic current is to be preferred; in others, the continuous galvanic current will usually give the best results. In either instance, the negative pole should be applied to the spine about the region of the supposed local trouble, the positive electrode being rubbed over the extremities, with a wet sponge in cases of paralysis, the electric brush, etc., in cases where various paraesthesias are the prominent features. The sances must be repeated every second or third day.

Third—As to hypnotism, I can only say that my own observations and experiments confirm the opinion of Mr. Earnest Hart, of the British Medical Journal, that the hypnotism of the Charcot school is but a delusion and a snare. I have never believed in the methods or results of the Charcot school—which has been barren of results, except in hysterical patients. But there is something in the hypnotism of the Nancy school as advocated by Bernheim and Leibault; if some of these patients in whom the mental trouble predominates were put into the hypnotic state and treated by "suggestion," good results may be attained.

Fourth—I am surprised that no allusion has been made to surgical treatment of these cases. When we are suspicious that meningeal hemorrhage is the basis of the trouble, we are justified in making an explanatory laminectomy for the removal of the clot—if it be present—even weeks afterward. This I have demonstrated. From a number of cases of trephining the spine, in my own practice, I feel sure that the time is not far distant when I shall open the spinal canal with the same impunity that I now invade the cranial cavity; and you all know of the success I have met in intra-cranial surgery. In one case, just now leaving the hospital, the patient had been in bed for many weeks with paresis of the lower extremities, accompanied by symptoms of marked irritation of the spinal cord. I found, on trephining the spine, a piece of bone pressing upon the cord but not penetrating the dura. Removal of this has given the most satisfactory results. The patient is now walking around the hospital, practically well, and will leave for home this week. So, the old assertion that we cannot trephine the spine is as absurd as the old idea that the brain is the seat of the soul, and so too sacred for the hand of mortal man to touch. Some cases must be operated upon at some point far distant from the seat of supposed injury; illustrating which I wish to refer to a case seen recently by myself and Dr. King. The patient was a woman who was injured and who sued for damages. I was to testify for the prosecution, Dr. King for the defense. To the credit of modern medicine and expert testimony, we agreed exactly as to the diagnosis and prognosis. We found this woman in bed, where she had been for two years since her injury. She was completely paraplegic, with incontinence of urine and faeces. Her legs were as totally devoid of sensation as any case of paraplegia I have ever seen—we could stick pins into the flesh to a depth of an inch at the most unexpected moment without the slightest evidence of sensation. Upon applications of the electric current I found the electro-muscular contractility to be still present, though the atrophy of disuse was most marked. The reflexes were exaggerated. I was now satisfied that we had to deal with a case of hysterical paraplegia, and that she was not a maligner; and further examination convinced me of the accuracy of my diagnosis, and that she

was innocent of any intention to deceive. Examination of the eye showed marked limitation of the field of vision and inversion of color perception, i. e., in bringing different colored yarns into her field of vision she saw the red invariably much sooner than the blue—the opposite of the eye in people other than those affected by hysteria. Having decided that her disease was undoubtedly hysterical in character, developed by the traumatism, we had to seek for the remote cause. We found a retroverted and prolapsed uterus, much enlarged, an ovaritis upon one side and a large pus tube upon the other. Here was the key to the trouble. For many months this grave pelvic disease had been undermining her nervous system; she was in such condition that if her house had burned or her husband eloped, the nervous system would have gone to pieces and “neurasthenia” would have resulted; but she was the subject of an injury, and so her nervous disorder was diagnosticated as “concussion of the spine.” Here was a case in which I was compelled to say that the injury was the exciting cause, and that, if Dr. King or myself would make a laparotomy and clean out the pelvis, the traumatic neurosis would be cured. It is such cases as this that make me suspicious of every case until I have made a thorough examination from head to foot, and which cause me to insist upon a careful attempt at a correct diagnosis before adopting any curative measure. If we will, in future, devote as much care in examination and expressing an opinion as the importance of the case deserves, we shall have less cause for chagrin at our mistakes than we have unfortunately had in the past. (Applause.)

Dr. Thos. H. Manley, New York, N. Y.—I deeply regret that time did not permit me last evening to present in full the conclusions which my clinical observation and experimental work have brought me. Now, sir, it is a very unpleasant thing to criticize adversely the conclusions of one's medical friends, particularly when they are honestly and earnestly expressed. But, at the same time, Mr. President and gentlemen, the purposes for which this assembly was convened, and for which some of us have traveled hundreds and thousands of miles, were, to a certain extent, to decide that vital question as to whether we can have a certain set of clinical symptoms without a corresponding set of pathological lesions. Because we know that, as a rule, in every other organ of the body there are no such things known as “clinical symptoms” without a corresponding pathology. (Applause.)

Dr. Emory Lanphear, Kansas City, Mo.—I would like to ask you, sir, if there are not certain cases of insanity in which a most careful microscopic examination fails to show apparently the slightest trace of pathological conditions?

Dr. Manley—I am not speaking of the psychoses. I am speaking of conditions which present physical changes—clinical changes which are attended with physical changes. (Applause.)

As an instance: If a patient has a cough and I hear him cough, if I listen to his lungs, or auscultate them, I know whether that cough is one which he produces as a maligner, and whether or not it has a pathological basis. The science of physics has enabled me to do that. Of all the organs of the body, there is none so well protected, so inaccessible in life or in death, or so difficult to get at without destroying as the spinal cord.

Of all the organs, nature has placed it the farthest beyond our reach. The other organs of the body may be twisted and displaced, but the spinal cord escapes. And it has been made the scapegoat of all injuries in recent times, from the fact that because of its inaccessibility it is impossible, in a

great many cases, to reach the ground work—diagnosis. We cannot, either by any visible or tangible evidence, during the life of the patient, determine precisely what those changes are that give rise to paraplegic symptoms. We must be guided very largely by inference.

Now, in the ninety-three cases which I have submitted and given in full detail in my paper, seventy-one on the human being and twenty-two on the lower animals, illustrating every type of traumatic spinal injury, there was not a single case of which a post-mortem examination was made in which we did not find clear and unmistakable pathological lesions which would account for the symptoms. I found in every instance in which paralysis followed the various types of injury; indeed, that there was a definite and peculiar set of pathological changes which accounted for the neurotic symptoms. Hence, if we cannot at this meeting come to something like a consensus of opinion on this question, our work to a very large extent has been a failure. As I said last night in my paper, Dr. Watson has opened the way by his experimental work to give us a true basis of the pathology which attends those cases. I would say, sir, further, with regard to my own cases of spinal injury treated at different times, that, without a single exception, my patients who left the hospital had no relapses; and I am not conscious of a single case in which the symptoms did not develop promptly after the injury. I have no recollection of such a case, except where a lawsuit was in the near prospective; otherwise, recoveries were prompt and permanent, the only exceptions having been those which I have seen in consultation and which, in the majority of instances, proved to be maligners.

I must disagree with Dr. King when he says that all these cases are feigned. I am quite sure that is not so. Among my histories there are several reported, two in particular, in families in which there was no litigation intended, the charge of negligence was not made by the patients, and in which the symptoms of paralysis followed the injury. But the diagnosis and the cause in these cases was quite clear. It was not a matter of suggestion. It was a matter of real, actual pathology in each, resulting from injury, and both of these cases made permanent recoveries. Owing to the unaccessibility of the spinal cord we cannot percuss it, see, feel or touch it, and when the case comes before a tribunal and they have to depend very largely on expert medical testimony, it behooves us to acquaint ourselves as thoroughly and completely as we possibly can with reference to the pathology which is assumed to exist. If there is any case in which it is so easy to get a judgment for an alleged or assumed injury, it is in those in which it is claimed that the spine has been injured. I remember a case occurring within the last six months in which a lawyer came to me and told me that I was to be subpoenaed as a witness for a woman whom I had attended some time previously. He said: "Three years ago you operated upon her for rectal fistula. We want you to go into court and swear that this fistula came from the spine." I said she is a morphine eater; she is a lunatic, and she is a woman who is simply working this company; she is an imposter, I honestly believe, and it cannot be possible that that woman expects to get a judgment or that you, as her lawyer, expect to get it. He replied: "Why, certainly we do." I was never so confounded in my life as when I heard that the jury gave her a verdict for \$3,800. It was one of the worst cases of extortion I ever heard of. There is no injury to the human body in which it is so simple to get a judgment if a woman knows how to work her points, as in an alleged injury to the spine.

Dr. Emory Lanphear—There is one point, with reference to surgical intervention as an aid to diagnosis. I was glad that was brought out because I had been waiting to see if any of the essayists would touch upon that question. Of course, we have been taught since the introduction of antiseptics that we could open about any of the serous cavities of the body with safety and impunity by the use of antiseptics. It is assumed that it would be a safe and simple procedure in cases of spinal injury to trephine and cut down and determine whether there was any fracture, hemorrhage or what not. If there was hemorrhage, remove it. If the bone was dislocated, driven in, replace the dislocation and elevate the depressed bone. If you will remember, Mr. President, the list of cases reported to this association, in every single case in which the spine was trephined after injury the patients, to a man, died; not a single one survived. In my experience I have just had two cases in which a fracture was easily made out by palpation, and in which it appeared to me at the time that it would be a simple matter to cut down and remove those fragments which were partially displaced. Acting on that principle, I operated in two cases—one in which the patient sustained a fall on the back of his neck and fractured the base of the arch of the sixth cervical vertebra. The fractured bone was very easily felt slipping about under the finger. The diagnosis was positive, and without making an incision, but it was thought that the proper course to pursue would be to cut down and remove that bone. I found it one of the most difficult surgical operations I ever performed. Not that it was not easy to get at the bone, but the hemorrhage was enormous—almost uncontrollable—and our patient died forty-eight hours after the operation. I think his chances would have been very greatly improved had we let him alone.

Another case, in which a man working in a lumber yard, while in a stooping position was struck in the mid-dorsal region, the processes of the fifth dorsal vertebra being fractured thereby. We cut down and removed the spinous processes, as well as one of the posterior lateral arches. There was not very much hemorrhage. The operation was simple, and it was not like that performed in the cervical region—terribly bloody; there was almost no hemorrhage. The only effect on the patient was that it greatly aggravated it. Although every possible precaution was taken to prevent septic contamination, our patient died three days later. I think his chances were very greatly diminished by cutting down and exposing the spinal cord; and I think that the mere exposure of the spinal cord will produce paraplegia and paralysis. I think that the recommendation to use an incision as a diagnostic aid is a bad one; that the practice is a vicious one, and that we have not had such results as to justify such a course. I certainly would say myself, if I were brought into court as a witness in the cases cited that the incision was responsible for a large part of the evil consequences which followed.

Dr. Thorne, Toledo, Ohio—I simply wish to relate a few cases which have come under my observation within a very short time, which may serve as illustrations and help us out. There are maligners, and there are conditions which simulate positive changes, and the results from positive changes. I have one case in mind in which the patient was suffering, as he claimed, from an injury by reason of a jerk in which his head was thrown forward and struck on the forehead; and as a result of what he called "concussion," he had paralysis. He was complaining of paralysis and his lawyers worked his case well. I called, in company with another gentleman, to see the patient. He met us at the door, took us into the

house, and hustled about to get us two chairs. We told him who we were and what our business was. He immediately began to simulate what he supposed was paralysis as the result of injury to his neck. Now, if there was any injury at all, it was an injury of the neck; but unfortunately we developed the fact that he was simulating cerebral paralysis; and he failed most completely in that respect. It is unnecessary for me to say to you what the accurate and true diagnosis of the real condition was. This man was a maligner. He secured a liberal donation from the jury in the first trial. His case had been in the lower court and he was now trying to obtain more money, which he didn't get, as he was knocked out of court by our establishing the fact that, if it existed at all, it was a cerebral paralysis and not a spinal paralysis.

Case Two—I went down to one of the large cities of the state, obtained a history of the case, and satisfied myself before I saw the patient that he was suffering from bulbar paralysis, and that the functions of all the nerves in that region were involved. We followed the case up and went to see the patient; found him with his mouth open, drooling, and the symptoms generally of a bulbar paralysis. Pushing the case a little further, we developed a case of syphilis. The case went into court, and it was concluded after the examination of the plaintiff's first witness. Our diagnosis as to syphilis was correct.

Within three months I had another case in the person of an engineer who, in getting down from his engine, stepped upon the engine step, which he said was loose and permitted him to fall to the ground. He had a convulsion. He was taken to his home and by and by had another convulsion; and in a little while he had a third convulsion. He was sent to me for examination. He had his wife with him and I sent her into an adjoining room. I made a very careful study of the case and developed a syphilitic condition—a positive history of syphilis. So I sent the man back to his physician and told him he would leave this case with the crucial test, which was the treatment; and, so far as I can see from the treatment, we have every evidence of as complete a recovery as it is possible to have when there is cerebral syphilis. Now, in my opinion, to get us out of this muddle we are in, we must make a more careful examination and study of our cases than seem to have been made by the gentlemen who have detailed some of the cases above.

Dr. Geo. Ross, Richmond, Va.—I would like to place on record, in discussing the question of maligning, a case of spinal injury which occurred upon a division of a road I had charge of. This man (blind) was asleep in a car which was standing still at a station. A freight car in backing up struck this car in which this blind man was sleeping, with sufficient force to knock over other persons who also occupied this car. This man jumped up suddenly and struck on his arm, back and hip. He walked out of the car, leaning upon the arm of someone, and, in two or three hours afterwards, claimed to be suffering from tingling in his feet; and, subsequently, paralysis from the loins down. Months passed and he was treated—intelligently treated, I take it. A number of months passed and he was completely paralyzed, to all intents and purposes. Skilled physicians attended him and pronounced his case hopeless. Litigation was instituted, the case came to trial, and a helpless object was brought before the jury—a perfectly blind man—apparently from his childhood, brought in on a litter, utterly unable to move, without sensibility of the lower extremities; had absolutely lost control of all ordinary powers. I met his physician on the street

while the case was in litigation, and astonished him by expressing the opinion that as soon as his case was decided he would be a perfectly well man. He was very much shocked by my assertion. The case was decided in favor of the plaintiff; the money was paid to him; and in six months afterwards I met him walking out to the church I attend. I see him frequently walking on the streets of the city in which I live now, as well as he ever was. The explanation of his recovery is that he had an attack of the "grip;" and the treatment I suggest for our cases of a similar nature is that they be given an "attack of the grip." My opinion, however, is that when the jury fixed his remuneration at some thousands of dollars, "enthralled no longer by disease, he was a gentleman of ease."

Dr. Wynance, Wyoming—I have listened with considerable interest to these papers and to the discussions upon this subject, but have failed as yet to hear a diagnosis of "railway spine." I learn from the different speakers that it is not acute myelitis, nor chronic myelitis, or sclerosis, or hemorrhage of the cord, nor malignering. I would like very much to know what we are discussing. If "railway spine" means an injury to the spine, or of the spinal cord, without an appreciable evidence of it, nor certain demonstrable symptoms of it, then I might discuss that question. But, as it is, it seems to me almost all of us are out of order. We are not discussing hemorrhage, myelitis or malignering. I would define "railway spine" as an injury of the cord without an appreciable lesion of the cord, nor a single demonstrable objective evidence of it.

Dr. Peck—I wish not to allow the sweeping assertions of Dr. Manley that in no other condition are such symptoms manifest—"physical symptoms," he termed it—without appreciable pathological lesions as an aetiological pathological factor. I would like to inquire if the aetiological pathological lesion of Basedow's disease, as have been certainly established, or of diabetes, do not exhibit as distinct physical symptoms as in "railway spine."

Dr. Outten—I desire to say a few words as a matter of privilege and to a certain extent in defense of the proposition which I have maintained. Our dear friend from Kansas City, Dr. Emory Lanpher, simply and absolutely obtunded every element of thought which I had, I do not know whether he intended to indicate the line of treatment which he alone follows or which the neurologist follows in his effort to obtain monetary gain. I have been insisting upon isolation and that drugs alone did not seem to accomplish very much in the treatment, but if our friend Emory missed anything in the *materia-medica* it was accidental. I would maintain irrespective of Dr. Lanpher or anybody else that in the treatment of a case of traumatic neurosis if the physician does not follow out the plain and natural line of treatment which is indicated and expressed in the word "rest" that he will inevitably make failure, should Dr. Lanpher give the medicines as he states he would, certain it is the lacking interval of time would debar the possibility of obtaining rest as demanded. Now then there is another thing he said, the surgical treatment of traumatic neurosis, if I understand this is a psychical trouble, situated in the cortex of the brain, what could surgical interference here do, trephine or still worse take off a section calvarium, slash the cortex and cure traumatic neurosis, radical is it not, but then what could you expect when in that condition where we had abscess of the brain or the old antiquated

condition known as *rammollissement cerebri* take out the softened brain and hoped to cure a condition. Again our friend has removed the Gasserian ganglion, heaven knows what else he will touch. But thank goodness deity has placed certain elements connected with the cerebral mass which it is impossible for him in the nature of things to touch. We have a body which is situated in the *cella-turcica* bounded on four corners by osseous pillars firmly held in place by prolongations of the *dura-mater* called the pituitary body. Thank heaven Emory can't touch this. Again situated away in the interior of the brain upon the base of the "lyra," a little gland described Des Carte, as the seat of the soul called the "pineal" gland. Thank heaven Emory has not ruthlessly torn this asunder. To be brief no realm of the brain is sacred to his touch. "Cacothus Operandi" is best that can characterize his treatment. Concerning trephining of the spinal column I am free to confess to having had nearly the same results which he has had in that operation, I have performed it several times. But the injuries were transverse and my patients passed to that unknown land from whence travelers never return. With regard to treatment I wish to say this, concerning my giving cerebrine and medalline, that I have never yet prejudged the opinions of any body, and I will never do it; in connection with scientific subjects. When Dr. Hammond's theory appealed to my reason and I sat down and studied the process under which Hammond made his animal extract I was sceptical, but was willing to trust. There is neither sense nor justice in condemning these things before we know what we are talking about. There is no person living, no matter how insignificant, who cannot revile any object and subject however sacred. I do not say that cerebrine is sacred at all, but why should you condemn Dr. Hammond until you know whether he tells the truth or not. No matter what Hammond may have been in the past or what he has done in the present or what he may do in the future, certain it is that he is a man who wears a No. 8 hat and has a great deal of brains and has taught more than a great many like Emory. For I know that I have received on more than one occasion excellent thought and rare good suggestions from this source, and I am free to confess that I admire Hammond.

CLINICAL REPORT.

By GEO. CHAFFEE, M. D., Surgeon L. I. Railway, Brooklyn, N. Y.

In collecting material for this report six hundred circular letters were sent out. They were addressed to chief surgeons, presidents, general managers and superintendents. In response two hundred and twenty (220) letters were received. Of this number one hundred and ninety (190) were letters of extreme courtesy, while the remaining thirty (30) replies related the history of but sixty-one (61) cases.

One reply contained a full report of an interesting expert examination for an alleged injury made by two well-known surgeons. Plaintiff brought suit and finally recovered a judgment of \$30,000.

This was some fifteen years ago, but it was a famous case, and I have considered it of sufficient value to lay it before your committee, and trust it will find a place in the transactions of this society.

I have not considered it wise on my part to burden this paper with anything more than the dry facts contained in the clinical report, a summary of which I will now give you as briefly as possible:

JOHN H. BERGEN, ESQ.

DEAR SIR: In pursuance of the order of the court for a physical examination of the person of Major John T. H—— we would respectfully report that as the result of that examination we find:

First—That the patient was in an extremely nervous condition, which might be determined hysterical.

Second—To test his memory we allowed him to tell his own story in his own way. He stated that "he had a pain in the back, running down his legs and then up the spine to his shoulder blades. That he can compare it to nothing but pins and needles sticking into him; that he has a headache, but when these pains, not like a galvanic battery, but like electricity or like pins and needles sticking into him, comes on when these headaches leave; that these pains sometimes run from his feet up to his waist and thence between his shoulders; before that he had a feeling as though a drop of water falling about three inches fell on this portion of his back. Since these shocks have come on he has not had that feeling of dropping water. Rubbing relieves him. They put bottles of hot water to his feet, but they do not warm him." During the giving of this description nervous shudders ran over him at times.

Third—He has a fresh, ruddy look, good color of face, hands, good color under finger nails, good color of ears. *He has not that prematurely aged look that incurable spinal disease gives.*

Fourth—*He does not spread his feet in walking to get a broad support, as he would if there was partial paralysis of sensation, as we should expect to find in incurable spinal disease. He walks with a cane, holding it in front of him.*

Fifth—*He curves his back in walking, also his neck; in incurable spinal disease they carry their back straight and their neck straight, as if an iron rod was run through their spine to prevent jarring the spine, and thus increasing his agony.*

Sixth—We wished to test him by going up and down stairs, but was refused, *the patient saying he had to be carried.* We would respectfully suggest that his house should be watched to see what he does when we are not there.

Seventh—To the sense of touch there is no difference in the feel of the legs; both feel colder than healthy skin.

Eighth—To test whether he could bend his back without pain, we had him sit straddle of a chair to auscultate his back, *he bent forward, curving his spine, thus negating the permanent disease of the cord.*

Ninth—To see if he could trust his spine we had him walk round the space between his bed and bureau, with the chairs intervening, which he did, turning among them, placing the hand on the chair or bureau to steady himself as he came to them.

Tenth—We placed a button on the floor to ask him to pick it up; he did it by using his cane to steady himself and getting down on one knee, but not keeping the "iron rod spine and neck;" "*he flexed his head and body to see it.*"

Eleventh—He complains of pain in one spot on the dorsal vertebra, corresponding to the attachments of the ninth and tenth ribs, but pressure along the course of the back over the ninth and tenth ribs on the left side he complained of pain. The same on the corresponding part of the right side, spreading the pain over too great a surface.

Twelfth—He has no difficulty in the retention of his urine and never has had during the whole continuance of this injury.

Thirteenth—His memory is good; he does not call things out of their proper names, but his ideas are well expressed.

Fourteenth—We had him write in our presence. The whole was written by him. The last sentence, "I want to go into the country," was from a copy made for him by his friend, Mr. C——. There is no misspelling, no dropping of the letter in the part without copy, as we should expect to find were there progressive disease of the spinal chord at this late day.

Fifteenth—There has been no convulsions, unless they should claim these "hysterical attacks" as such.

Sixteenth—Pulse 98 strong, second examination after the excitement of the examination 84.

Seventeenth—Measurement of chest, 36 inches; left side, 17½; right side, 18½ around on a line of ensiform cartilage.

Eighteenth—Measurement of chest around line of the nipple left, 18; right side, 19.

Nineteenth—Auscultation and percussion shows respiratory murmur fully restored and the lung is freely performing its duty through the whole of the left lung.

Twentieth—No depression of ribs found, as we should expect if the ribs had been driven in on the lung.

Twenty-first—Jarring the spine causes intense pain in the degeneration of the spinal cord.

Dr. Hutchinson percussed his chest on the back of it thoroughly and there would be no complaint except when he was over the so-called tender spot.

Twenty-second—Dr. Johnson diverted his attention by getting him to count while listening to his chest in front, and while steadying his head against the chest by pressure of the hand on the back, and keeping him repeating the counting as the head was carried over different portions of the front of the chest the hand was at times pressed firmly on the so-called tender spot and while his attention was diverted by counting he did not notice the firm pressure. As soon as he was allowed to see or revert he would complain of great tenderness there even when the fingers were hardly touching the place.

Twenty-third—Dr. Johnson, in carrying his head from point to point

over the front of the chest to listen, would have his hand pressing on the back and would suddenly remove his head, thereby jarring his spine, and there would be no complaint of pain, *this sudden changing, in true degeneration of the spinal cord, would cause great pain.*

Twenty-fourth—Dr. Hutchinson developed it still more thoroughly, with the patient stripped; he had a tape measure and measured around the chest on a line of the bottom of the breast bone, telling me to keep my finger firmly on the breast bone, to look at the mark; he held firmly the tape *directly around the so-claimed diseased vertebra* and compared the measurement of the diseased with the sound sides, and whilst the patient and physician thought we were measuring to get the exact measurement of the chest—that is, the changes that had taken place from the claimed injury of the chest, he was drawing the tape firmly over the so-called diseased portion of the spine. After apparently having made a mistake in addition, 18½ for right side and 18 for left and only 36 inches for the whole measurement of the circumference of the chest, he held his own hand on the diseased point, with the tape drawn tight, and bent round to see if I was making a mistake in my central point in front. To avoid the possibility of a mistake the ground was gone over above on a line with the nipple and measurements recorded. We again came back to the tender portion of spine and measured, keeping the tape firmly drawn *so as to get the comparison of the two sides accurately.* During all this uncertainty of the exact disproportion of the sides firm pressure of the tape was kept on the tender point without complaint.

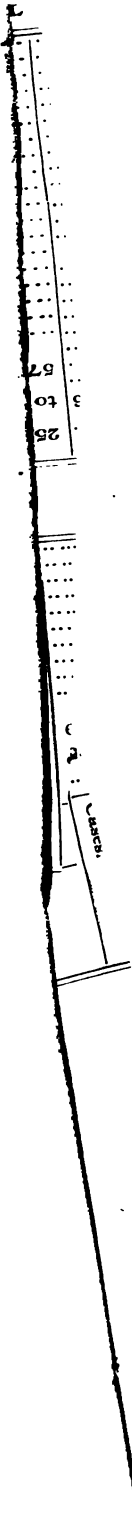
Twenty-fifth—The body is well nourished. The muscles firm. No apparent wasting of either limb—we did not measure them, as his friend, Mr. C——, was on the anxious seat lest we should tire him, and from the general appearance of the man we did not deem it absolutely necessary.

Twenty-sixth—His friend, Mr. C——, volunteered the statement that “he had not had an erection of the penis since the injury.”

Twenty-seventh—As a conclusion we do not think that this is a case of incurable spinal disease, but one of those nervous cases of hysteria, resulting from long continued worry, often seen in railroad cases; it is corroborated by his mournful expression, “Dr. Freer said I was afraid,” which his friend, Mr. C——, said he was continually repeating.

We think this case will rapidly recover as soon as settled, under simple change of mind and country air.

JOHN G. JOHNSON,
JO. C. HUTCHENSON,





CHAPTER III.

MISCELLANEOUS PAPERS.

Report of a Case of Contusion of the Abdomen and Back,
Followed in Five Months with Intestinal Lesions.

[By SURGEON PAUL F. EVE, Nashville, Tenn.]

On the evening of Nov. 19, 1892, I was called upon to attend Mr. C. A. McA., a brakeman on the Henderson division of the Louisville & Nashville Railway, who had been injured near Guthrie, Ky., on the morning of Nov. 18th by falling between the engine and cars, his body being caught between the bumpers of same. I learned from those who first reached him that when extricated he was unconscious and remained so for several hours. He was taken to Guthrie, Ky., and there attended by a physician until the next day, when, by his urgent request and that of his family, he was removed to his home in Nashville. The physician who attended him gave him stimulants and a hypodermic injection of morphine to relieve pain. When seen by me he was still suffering from shock, and complained of great pain in abdomen and back. He stated that he had had several vomiting spells, and those who were with him remarked that the matter vomited was of a dark character and of an unpleasant odor. I asked how long since vomiting commenced, and was informed it took place about three hours after injury. Stimulants had been freely given during his trip, and vomiting had occurred several times during his journey. As soon as possible I began an examination of back and abdomen, but was deterred from doing so by his complaining of extreme nausea, followed by a dark and offensive emesis of a stercoraceous character. When vomiting ceased and patient became quiet, as careful an examination was made as possible, which revealed two large excoriations on back, extending from the ninth dorsal vertebra to the middle of the sacrum and running inward to about one-half inch of the transverse process of same. No excoriation or even redness could be discovered upon the abdomen, but it was tympanitic and

tender to touch, and so great was the pain elicited that a further examination was abandoned. Upon questioning him, I learned that he was of a constipated habit, and had not had an action upon his bowels for five or six days previous to his injury. His pulse was quick and feeble, 130 to the minute; respiration 28 to the minute and temperature 101 degrees. I left one-grain doses of calomel, to be given every three hours until four doses had been taken, and gave him a hypodermic injection of morphine and atropia to induce quiet. I saw him early the next morning and found that the calomel had quieted his vomiting for five or six hours, but that after that time he had vomited the same characteristic matter as before, and that no movement had occurred from his bowels. He was very restless and complained of a tightness and great pain in the abdomen. By means of a rectal tube, inserted as far as possible, an injection of senna, salts and oil, in hot water, was administered, followed in two hours by a copious action, containing quantities of scybalous masses, to the great relief of the patient and my own gratification. Several other actions occurred the same day. In the evening the patient was almost free from pain, pulse stronger, 102 to the minute; respiration 22 to the minute and temperature 100 degrees; abdomen flaccid and but little pain complained of. Upon examination, no enlargement of abdominal viscera could at this time be detected. I placed him upon a tonic treatment of strychnine, phosphoric acid, etc., and ordered a restricted but nutritious diet. An unguent in the meantime had been placed upon back, but excoriations upon the third day looked angry and began to take on an ulcerative action. Four or five large superficial sloughs were removed on the twelfth day, but under antiseptic treatment the wounds did nicely and were entirely healed at the end of the fourth week. The patient during this period made a very slow and tedious convalescence and complained every now and then of colicky pains of the bowels, although they were regular, moving once each day; attended with no pain at stool; pulse ranging from 85 to 98, respiration from 20 to 22, and temperature from 99 to 100 degrees. Although quite weak and suffering with occasional colicky pains, he was enabled to sit up for a short while at the end of the fifth week, and to walk about the room at the end of the sixth week. Repeated examinations failed to discover any fracture or dislocation of any of the vertebrae, and the patient's history was not that of strauuma or tuberculosis. His appetite had at this time become fair, and he was enabled during the eighth week to be driven to my office. At this visit he still complained of colicky pains, and, attributing them to fermentation of food, I placed him upon lacto-peptine, bismuth, etc., followed by willow charcoal, but he received but little or no benefit from them. These colicky pains became more severe and frequent, and at times he suffered greatly. He visited me again two days later, stating that the night before he had been taken with a severe pain in his bowels, and that on awakening he had been startled by hearing a gurgling sound in his bowels, which was followed by knotting of same, and which he could distinctly feel through the abdominal wall. During this visit and just before examination was commenced, he was taken very sick, placed upon the bed and abdomen exposed for inspection, and, as there were several of my professional brethren in the office at this time, they were called in to assist me in conducting the examination. A violent cramp came on, and not only could we feel, but distinctly see the knotting of bowels through the abdominal wall, confined to the hypogastric, right and left lumbar regions. These symptoms lasted for about one minute, and the patient suffered great

pain during that time. Consultation was called in and patient closely watched. He still continued to have one action every day and complained of no pain at defecation. Every remedial agent that could be thought of or suggested was tried and diet restricted, but to no avail; patient still at times suffering with the above symptoms, which could only be relieved by large doses of opium. This state of affairs continued on and off during the whole of the after treatment. About the twenty-third week, finding his condition not improving, and believing a change might benefit him, with the consent of my consultants, the patient was sent to the country, where he remained for two weeks. To our great disappointment, no change for the better occurred; but, on the contrary, his condition gradually grew worse, and the symptoms above described became more frequent and painful. During the whole of this time, when the patient was not suffering from pain, he was enabled, though very weak and feeble, to sit up or walk about a little. Upon his return to the city he was brought to my office and stated he had noticed a few days before leaving the country a hardness in the lower part of the abdomen. Upon examination I found an induration in the hypogastric region, extending into the left inguinal and reaching to the left lumbar. There was no particular pain upon examination and no fluctuation could be discerned. Thinking that an abscess was forming I ordered hot fomentations to the parts and visited him the next day. When I saw him I found induration softer and thought I could discover some fluctuation. That evening I was hurriedly telephoned for, and was informed that the patient was suffering excruciating pain, but upon arrival found him entirely relieved, examination revealing the fact that abscess had ruptured and was running freely. Fomentations were continued and abscess still discharged freely. The next day, upon examination, the aperture was seen to be about one-fourth of an inch in diameter; while I was there spasm of bowels came on, accompanied by a flow of pus, followed by gases of a decidedly faecal odor. Diagnosis of fistulous opening of intestine fully confirmed next day by discharge of faecal matter, as also by smell of onions, which had been eaten the day before. The condition of my patient, which had at no time been good, became much more unfavorable; pulse weak and vitality low. By consent, patient was removed to hospital on April 30, 1893, and preparations made for active measures if deemed necessary. Notwithstanding the dietetic and medicinal treatment instituted he gradually grew worse, and by advice of consultants I made an operation upon him on May 4th. When abdomen was opened it was found that the external opening led into a fistulous tract about eight inches in extent, running in a direction upwards from middle of the hypogastric, through a portion of the left inguinal to left lumbar region. The ileum was firmly bound down to the tract by adhesions and considerable force was required to separate it. Three openings of the ileum were brought to view, all of which communicated with the fistulous tract. Two of these had ulcerated almost three-quarters of the circumference of the gut, while the intestines, above and below, were greatly distended. These openings of the ileum occurred at its lower portion, about eight inches from ileo-caecal valve. About twenty-four inches of the gut was excised, and operation for uniting ileum to colon determined upon. The patient sank rapidly, and, the lower segment having been sutured together, the patient being now in a dying condition, the upper segment was brought out to right inguinal region so as to form an artificial anus, and the abdomen closed as quickly as possible. The patient survived the operation twenty-four hours.

An autopsy was made four hours after death, on May 4th. Special attention being paid to the solar plexus of nerves, as my diagnosis, in which my consultants concurred, was concussion of said plexus followed by inflammation. The intestines were markedly distended, especially the large ones. The tract was measured and found to be about eight inches in extent, and large scybalous masses found in large intestines. The solar plexus and Splanchnic nerves were found to present inflammatory evidences, and the mesentery of large and small intestines a similar condition. Just below the solar plexus, on the left side, was found a sphacelated space, one inch in circumference, and the peritoneum, which we expected to find thickened, etc., was contrary to our expectations almost normal in condition, save in the portion around fistulous tract. No fracture or dislocation was found, though carefully sought for, and all the other abdominal viscera found in a good condition, save evidences of slight inflammation.

When we take into consideration the length of time elapsing before any definite pathological condition manifested itself, save those of occasional colicky pains and cramps, I think I am safe in concluding that there was at the time of the injury no lesion of the bowels or undue inflammation of the abdominal viscera. If there had been, they would have inevitably presented themselves long before they did by unmistakable symptoms.

When we review the literature of inflammation, we ascertain that it spreads by either continuity or contiguity of structure, through the lymphatics or blood, or finally through nervous agency. Now I reason, had it followed the first two methods, it would have shown itself by symptoms marking such progress, but as before stated, these did not appear. If through the blood or lymphatics, phenomena peculiar to this morbid conditions ought also to have been detected, but they were conspicuously absent; and as we are confined to the last of these methods, viz.: nervous agency, and as it is so subtle in its action, I shall unhesitatingly pronounce this as the avenue through which it progressed. Yes, I believe that the solar plexus, through concussion of its fibres, etc., formed the origin of this trouble, and from this as a center, inflammatory action spread through the various nerves which issue from it, carrying its baneful influence also to those nerves which are received into this plexus. Viewing the anatomical construction of this plexus, we find it consists of a great network of nerves and ganglia, which receive the great splanchnic nerves of both sides and some filaments from the right pneumogastric, and distribute these branches to the viscera in the abdominal cavity. One of its branches, the superior mesenteric plexus, surrounds the superior mesenteric artery and distributes nerve filaments which supply all portions that receive this vessel.

The intestinal canal contains an automatic motor center within its walls, the plexus myentericus of Auerbach, which lies between the longitudinal and circular fibres of the gut. It is this plexus which enable the intestines when cut out of the body, to execute, apparently spontaneous movements for some time. If this center is not affected by any stimulus, the movement ceases. This condition being termed aperistalsis. When blood, containing the normal amount of blood gases, passes through the intestinal blood vessels, the quiet peristaltic action of health occurs; called eupistalsis; that is, provided no other stimulus be applied to the intestines. All stimuli therefore applied to the above plexus, increases peristalsis,

which frequently becomes very violent, causing evacuation of the contents of the large gut and also producing spasmodic contraction of the musculature of the intestines. This condition being known as dyperistalsis. The continual application of strong stimuli, produces intestinal paresis or exhaustion, which finally results in complete paralysis of the intestines. In this condition the intestines are greatly distended, as the paralyzed musculature does not offer sufficient resistance to the intestinal gases, which are expanded by heat. This condition being known as meteorism.

The action of the splanchnic is four-fold. First, it is the inhibitory nerve of the small intestines, as long as the circulation is undisturbed and the blood in the capillaries does not become venous. When this latter condition takes place, stimulation of the splanchnic increases peristalsis. Second, it contains inhibitory fibres which are easily exhausted by venous conditions of the blood; and also motor fibres which remain excitable for a long time; as after death stimulation of the splanchnic always produces peristalsis, similar to stimulation of the vagus. Third, it is the vaso-motor nerve of the intestinal blood vessels and thus governs the largest area in the body. When stimulated, all the vessels of the intestines containing muscular fibers contract; when divided, they dilate. Lastly, it is the sensory nerve of the intestines and under certain circumstances gives rise to very painful sensations.

It has been known for a long time that injuries or diseases of nerves may act as predisposing causes of inflammation and its results, by diminishing the natural powers of tissue to resist external influences, to which they are frequently and unavoidably subjected. Thus, after injuries of the spine, sloughing of the paralyzed parts takes place by influences almost imperceptible, and which in health would have never taken place. Carbuncle, a disease in which inflammation enacts such a prominent part, appears to be frequently associated with diabetes, which there are great reasons for believing to be an affection of the nervous system.

Some very interesting experiments conducted by Dr. Meisner seem to show further that certain nerves exercise a peculiar trophic function, and that lesions of such fibres may be the immediate conditions of the parts supplied.

Now, if I am correct in my diagnosis, that there was first a concussion of the solar plexus (and when I first saw my patient he was suffering greatly from shock), followed by inflammation; we can readily see how at first, from sensation traveling to splanchnic nerve, we could have the inhibitory action of this nerve upon the intestines, producing symptoms of intestinal obstruction, etc., shown by stercoraceous vomiting, etc., and how under the influence of inflammation, the venous blood filling the capillaries and stimulation of the splanchnic continuing, increased peristalsis took place, as exemplified by the colicky pains, etc.; and as greater stimulation was brought to bear upon this nerve, spasmodic contractions of the musculature of the gut occurred, shown in the knotting of the bowels, seen and felt through the abdominal wall at various times. Now after a given length of time, these conditions steadily going on, by continual stimulus, intestinal paresis occurred. Complete paralysis first affected the lower part of the small intestines, which through inflammatory conditions, resulted in sloughing of the Ileum, producing the three openings above described, the formation of a fistulous tract, and an external opening in the hypogastric region, much in the same way as carbuncle makes its appearance in diabetes. And, that finally, complete paralysis of the

whole intestinal canal supervened, as revealed in the distended conditions produced by intestinal gases, and further by scybalous masses in the large intestines, the paralyzed gut being unable to evacuate itself.

DISCUSSION ON DR. EVE'S PAPER.

Dr. W. B. Outten stated that this was a paper which should not go without discussion, especially when the doctor's lucid explanation of his case was taken into consideration; and for the further reason that one of the subjects of the annual meetings of the association is to bring forward for discussion a class of cases corresponding exactly with that reported by Dr. Eve. "It is a rare paper. Regarding railway injuries it will be found that so far as the American surgeon is concerned in comparison with his professional confreres across the water it is frequently seen that we are away behind. There is a condition described by the French, and the time is not far distant when it will be almost as freely discussed in connection with railway injuries as the so-called "traumatic neurosis," that condition described by Dr. C. L. Courtanet of Rouen called "entasis," which means "stretching." This condition was frequently observed after railway injuries, with which doubtless most of the surgeons present were familiar."

The Relation of the Railway Surgeon to Public and International Hygiene.

[By SURGEON R. W. BRUCE SMITH, Scaforth, Ontario, Canada.]

The object of this paper is mainly to present a few observations in regard to the position occupied by the railway surgeon in relation to the legally constituted health officers, and to direct attention to the enlarged sphere of usefulness, now inviting our attention, in protecting the welfare of the public and our railway corporations, while exercising a salutary guardianship over the sanitary interests of both.

The railway is a public carrier, and as such is responsible not only for the lives of the persons it carries, but also is bound to protect its patrons and employes from any of the dangers to health to which they might be exposed, and which with a reasonable exercise of precaution it might be possible for them to avoid. The railway has thus direct relations to the individual, the municipal and the national well-being. The surgeon as a paid officer of the railway has responsibilities the same as the company, which employs him, so far as the health of the individual or the general public is concerned. Thus his relations are primarily as a surgeon to take charge of accidental injuries, to attend all cases of sickness among the employes committed to his care, and to prevent injuries whether surgical or medical. The latter duty places upon him in a measure the work of a health officer for the railway, whose special interests he guards. This means prevention in its widest application whether to the sanitary appliances and ventilation of trains, the observance of hygienic principles in the construction and equipment of stations, the water tanks, closets, etc., both on cars and at stations, the character of berths in sleeping cars, as regards freedom of blankets from infection, etc., the supplying cars with

good ventilation, the thorough cleansing of coaches at proper intervals, and the disinfecting and cleansing of cars, which have carried immigrants. I may add to this the arranging at certain railway points for detention buildings, where, as in the case at those places, where there is an interchange of railway traffic between American and Canadian railways, and a constant liability for immigrants to be thrown on the care of a railway company by the health authorities of either of these countries.

Exception may be taken to the rather lengthened list of duties, which I have mentioned by those who think that our services should not cover such a wide range, but the experience which some railways have had in the past has emphasized the importance of the railway surgeon being at all times ready to advise in matters where harmonious co-operation between municipal and national health authorities with the railway corporation is desirable.

If we are ready to admit that upon the railway surgeon devolves the duties of a railway health officer, there opens before him a greatly enlarged field for usefulness. In this age, so marked with improvements calculated to enhance the enjoyment of our homes, there is an unmistakable demand for the introduction of the best appliances likely to increase the comfort and healthfulness of our railway coaches and stations, thus assuring to the thousands who travel the most desirable hygienic surroundings, that can possibly be secured. The haste with which the railway interests of this continent have been pushed has probably furnished some reasonable excuse for the deplorable neglect manifested in the lack of attention to the sanitary requirements of some railways, but has the time not arrived when a change in this respect is expected? There is, I am glad to note, satisfactory evidence that some of our leading lines are of late years showing increased interest in matters relating to sanitary improvements in their property with the laudable object of promoting the hygienic welfare of their patrons. There is, we will all admit, abundant need for these reforms.

The subject of car ventilation has not been neglected, but on how many roads can it be said that a satisfactory system prevails? Too frequently we notice that the only provision for the escape of foul and the admission of pure air to a coach is made from the roof instead of from the lower portion of the car. It is now generally admitted that the system of car ventilation that will obtain in the future will be provided with heaters placed underneath the middle of the car with ventilators on a level with the floor for the removal of the foul and cold air by means of a conduit. Car heating by electricity is likely to receive a trial, but as yet we are unable to pronounce as to its merits. The traveling public have crude ideas in regard to ventilation, and must be taught by rigid regulations forbidding the indiscriminate opening of windows and doors, that such actions will destroy the object of any system, calculated to afford a properly regulated temperature. Some have suggested that it would be conducive to the health of all if car windows were made perfectly fixed with rubber fittings so that they could not be opened. The best methods of car-heating have also been carefully debated, but these controversies have not succeeded in removing the heaters, which generally stand at one or both ends of the coach, where in the case of a wreck they are most likely to be the means of the car taking fire. I believe that the time is rapidly approaching when the foul smelling oil lamps and gas as means of lighting passenger coaches will give place to the incandescent system, now used on

some roads with such satisfactory results. May we not indulge in the hope that the recently introduced method of car heating by electricity shall ultimately banish the end heater from our coaches? My experience is that railway companies are anxious to provide in these days of competition what is safest and most healthful, and that just as soon as these newly introduced methods shall have passed beyond the range of experiment, we may look for greater improvements in the ventilation, heating and lighting of American coaches.

Some have suggested that conferences between master car builders and members of this association might be productive of much benefit, and I feel sure that no member of this association would consider it beyond the line of duty to offer suggestions that might result in securing for the traveling public coaches, in which a better system of ventilation and heating would be provided. Certainly our suggestions will be of little avail, unless assisted by the co-operation of our master car builders.

The sanitary appliances of railway premises and rolling stock have doubtless been greatly improved, but here, also, the skill of the railway surgeon as a prudent sanitarian may be productive of much good. Increased travel has rendered greater attention to hygienic surroundings absolutely necessary. On our Canadian roads there has been great advancement in these respects during late years. Our stations are faithfully inspected, and every effort is made to keep the water closets in a sanitary condition. The foul odors that too frequently are complained of, coming from the end of the cars near the water closets, certainly deserve attention. These generally arise from the urinals being too poorly ventilated, or from being too narrow in the outlet. The remedy, I believe, lies in altering their construction so as to make them more open, thus to remove the likelihood of debris collecting to pollute the air. These urinals and water closets should be douched at frequent intervals, say at every divisional point passed, by either chloride of lime solution or carbolic acid water. Some have recommended dry earth closets as suitable for railway coaches. Since the introduction, thanks to American ingenuity, of a method by which we may have a durable porcelain-lined vessel for water tanks, the danger of drinking water, being contaminated with ice of a doubtful origin, may be avoided. The coming water tank for railway coaches and stations is likely to be a porcelain-lined vessel, which can be kept perfectly clean by having rubber fittings and being kept securely locked down. This vessel, placed in a larger one and packed around with ice and salt, will furnish a cool drink of water which has never come in contact with any dirty ice. The danger of infection from the berths and blankets of sleeping cars is worthy of consideration, and the railway companies which can offer to the public assurance that nothing that sanitary science can suggest is left undone by a thorough system of disinfection to secure, as far as may be possible, perfect immunity from danger, will acquire and retain the fullest confidence. On those routes which are patronized by phthisical patients, while en route to Southern and Western health resorts, is there not a danger that by the careless treatment of the sputa of such persons the germs of that dreadful disease may be disseminated? I would suggest that to railway surgeons should be assigned the duty of seeing that the porters on the cars of these routes, to which I have referred, are properly instructed in the use of some of the well-known methods by which all danger from the spread of the bacilli of phthisis may be avoided.

In our Canadian provinces, and I have no doubt the same law obtains in this country, all persons suffering from, or who are known to have been exposed to, any contagious disease, are forbidden to use a public conveyance, but in spite of these regulations there is too frequently reason for believing that infection is spread through lack of attention or willful, may I not add criminal, carelessness on the part of the traveling public. While it would be probably too much to expect that ticket agents should require a health certificate from travelers, it would be well for railway authorities to let the public understand that persons who persisted in needlessly exposing their traveling companions to the dangers of contagion are, in every instance, unlikely to escape legal prosecution. Probably this apathy on the part of the people may gradually be removed as the principles of hygiene become better understood, and to this end the introduction of the study of sanitary science in our public schools cannot be too highly commended.

The proper cleansing of cars might be done advantageously by persons working under the supervision of the railway surgeons. We are all familiar with the fact that persons employed where dust largely prevails are often greatly injured thereby, and the respiratory organs frequently suffer irreparable damage from such causes. Is there any remedy likely to prevent our railway coaches, when used on long runs, becoming hurtful to their occupants from the accumulation of dust therein? A Canadian railway, which boasts of its through trains from ocean to ocean, takes the precaution of removing all passengers and hand baggage from the train at certain points, and subjects each car to thorough cleansing, and, if necessary, fumigation, and these precaution for the benefit of the passengers are highly appreciated. Those cars which are used not by immigrants alone, but by persons who eat, sleep and pass the day and night therein, should receive particular attention. For these, thorough scrubbing with hot carbolic solutions, and afterwards fumigation, are necessary. Sulphur, the first disinfectant used by the ancients, still holds a first place for successful fumigation, and is probably the best agent we possess for purifying the atmosphere of cars, or for disinfecting bedding and clothing.

There can be no fault found with our national health authorities in carefully guarding those railway points where persons coming from any district where infectious diseases exist, or who are themselves suffering from such diseases, are likely to enter the country. I can assure you that the Canadian health authorities are just as anxious as those in this country to prevent the spread of infection, and are always ready to heartily co-operate in any measure, no matter how stringent, which has for its object the stamping out of disease. And in the case of any epidemic, our authorities are as determined to prevent the spread of the contagion across your borders as to limit its ravages within our own bounds. In these matters, as well as in all others, may the harmony and good-feeling between these two nations never be disturbed. At those points where Canadian and American railways meet the railway surgeon, by hearty co-operation with the health authorities, while guarding the interests of his own company from unjust discrimination, may do much to promote the welfare of those unfortunate enough to be quarantined, and at the same time afford the public health authorities every means of carrying out the regulations necessary to the public weal.

The railway corporations are, I believe, gradually being brought to recognize the necessity of acknowledging its surgeons as persons whose qualifications as medical men adapt them for a wider range of usefulness than merely to take charge of accidental injuries. The railway surgeon who accepts the increased responsibility of protecting the health, not only of the company's employes, but also of the thousands who throng our railway coaches, will have abundant opportunity for the exercise of his skill as a sanitarian in promoting the safety and well-being of the traveling public.

I shall not attempt to adduce any formal conclusions from the few observations I have made in this brief treatment of a subject which, I am well aware, deserves more important mention than I have been able to give it in this paper, but I shall trust what has been said will lead to a discussion more fruitful in results than anything I could possibly offer.

Superheated Steam as Applied to Ships and Railroad Coaches as a Germicide.

[By SURGEON JOSHUA CHITWOOD, Connersville, Ind.]

Disease has claimed a greater number of victims since "the vaped force" has pushed and pulled with all the energy of a concentrated power which is only surpassed by the mysterious electricity itself than all other causes combined. The loss of life upon the tented field has not been nearly so extensive by "shot and shell" as that resulting from the many diseases incident to the surroundings to which the soldier was exposed. The medical profession should recognize these acknowledged and admitted facts in office and conclave, and in recognizing them should take measures to lessen the evident disproportion in the casualties of the civilized world. The medical profession is expected to be stationed upon the towers of public safety and protection, and the members of that noble calling may profitably devote a portion of the time consumed in society deliberations to the study of means of alleviation, relief and cure of the large percentage of the human race, who at this time are so much in need of assistance.

Indian or Asiatic cholera has in all probability existed from the hour that the deep ganges first started on its long march to the sea; in other words, from time immemorial. But recorded observations only extend backward to the years 1774 and 1775, at which time, we are informed, the lurid lightning of its dread artillery lit up the then inhabited world and a periodic devastation of humanity was inaugurated which, in defiance of the investigation and skill of the greatest medical thinkers of either continent, has claimed more victims than have been sacrificed to all other foes of human life.

Let us halt for a brief space and contemplate the ravages of the terrible epidemic:

"Which the dire contagion spread
That heaped the camp with mountains of the dead."

On the gloomy field of Pondicherry 60,000 faces were shrunken and blackened by death in a single day.

We observe its march from a safe historical distance of more than one hundred years and see it enter Madris, which was almost depopulated, and in the year 1817 it suddenly and without warning appeared at Jessora and Bengal and a terrible quota of the unhappy populace was demanded and contributed to the dreaded foe.

The disease next commenced its march and passed rapidly along the coast of Coromandel, and in Bemoris alone 15,000 submitted to the deadly conquerer.

Fully one-half of Gen. Hastings' splendid army of 18,000 well-equipped and picked soldiers succumbed to the malady. It next scaled the highest mountain peaks of Hindostan and Nepaul and exhibited a fatality in the greatest altitudes fully equal to the destruction of life displayed in the marshy plains 4,000 feet below the lofty vales.

Calcutta was visited by the epidemic in 1827, at which date it receded from the front and returned to its first starting place. After replenishing fresh supplies of its exhausted powers it soon began an energetic march to the heretofore ignored territory of Africa and Europe. Orenburg was attacked in the year 1828, with fatal result to many of its inhabitants. Next the Caspian sea was reached by its advancing columns, which disregarded the sturdy, towering heights of the Caucasian mountains, and thousand of the stout and rugged mountaineers succumbed to the virulence of the epidemic. The mountain streams were all infected with the cholera poison and the fish were found dead in great numbers. Nor were the domestic fowls or wild birds spared by this foe to human life.

Mr. President, in this hour of threatened return of cholera to our shores, at this time when all eyes are turned with anxiety towards the east and are awaiting tidings from the outposts of the enemy, expecting our videtts to be driven from their posts of honor by the advance guard of an unrelenting foe, we as members of the medical profession are expected to defend the people from the threatened danger which is to-day menacing the millions of beings who inhabit the western hemisphere. But how are we to accomplish this grand movement and in what manner are we prepared to meet this advancing army? We should carefully examine our armament and assure ourselves of our ability to act before promising the public that assistance and safety which will enthuse them with sufficient confidence to aid us in our endeavors.

Happily the aetiology of cholera is no longer veiled in darkness. The sunshine of science has dissipated the dark and seemingly impenetrable cloud that rested over it and obscured it from all worldly vision. It is not now necessary for the poor deluded Indian woman to weepingly plead to be allowed the sacred privilege of being incinerated upon the funeral pile of her husband who had fallen a victim to the devouring epidemic, as a hundred years ago she prayed in order to propitiate her god and stop the reign of terror with which her people had been cursed.

The cause of cholera has been demonstrated to the full satisfaction of all to be the cholera germ that is introduced into the human organism through the nostrils or mouth, which rapidly finds its way into the alimentary canal, and after a brief time is multiplied into millions and the phenomena of the disease is produced. The seeds of cholera are rapidly

communicated by means of air and water or both, resulting in a fatality that seems to be incredible. It feeds upon the material that it creates, and thrives upon the victims that fall before its advancing columns.

The question now arises, how can we remove the pabulum that feeds this disease. If we can accomplish this great work we shall be enabled to confine the epidemic in its own castle and thus rob it of all the horrors it displays to those who exist outside of or beyond the germ-filled atmosphere of India, Asia or any other country separated from us by a wide and pathless ocean.

But just how the germs that cause this disease can be destroyed within or without their human habitation and precisely how the fuel that feeds the flame shall be removed out of harm's way is a question that is not easy to answer. Many theories have been advanced, but most of them after being tested in the fire of practical utility have been proven utterly worthless and have faded before the test to which they have been submitted and disappeared into the distant vista of the many theories that have preceded them. I certainly therefore appreciate the responsibility that a "theory advancer" is placed in and feel a degree of hesitancy in appearing before you in that role. But as the theory I advocate is endorsed by practice and is only claimed by me in its application in connection with railroad carriages and ships, I venture the proposition that my courage will be equal to the occasion.

I define my position to be confined to the assertion that heat alone will destroy all germs, when properly applied, whether in a dry or a moist state. But before considering this text let us consider briefly the very important means that should in all epidemics be resorted to. I mean quarantine. Although "forty days" has been handed down to us through various changes incident to more than seven hundred years of past experience, and although the origin of the terms itself has been almost forgotten and is sadly misconstrued in its meaning and is not now in any particular what it was when originated centuries ago; yet for all that has been said concerning it, pro or con, it has ridden upon the rising and falling waves of passing centuries, sometimes clearly discernable to the entire world's admiring gaze and at other times darkened in the sinking billows of obscurity. But after all the changes and differences of aspect and phases presented to the millions who have been spectators and are now numbered with those who are no more on earth, the principle is to be admired and praised for the good it has done, for the comfort it has given to the human race when all else was enveloped in profound midnight, and for the promise it gave of a rising morning sun out of the darkness which pervaded the world.

Quarantine certainly possesses many virtues, when properly and judiciously conducted; but, like all means of real benefit to mankind, it is also capable of doing harm to a degree commensurate with its capacity for doing good. Going as it does hand and hand with commerce, its associate seems to be an uncongenial companion. When commerce is interested in the principles which contribute to the prosperity and growth of free and unrestricted communication on the sea or land, which connect one nation to another in the bonds of trade and traffic, then does quarantine shrink from the noisy tolling wheel or rudder and claims seclusion and retirement from the usual avocations of man. The interests then of commerce

and quarantine are quite at variance. "How can two walk together if not agreed?" is a question asked in the divine book. In answer we can say it can only be accomplished by exercising the principles of "give and take." Quarantine cannot be placed as a barrier to the commerce of the world by laying upon her the heavy hand of international law that would detain her for forty days. This would not be endured by the business spirit of nations, unless it might be absolutely necessary in order to protect a nation from the horrors of a fatal epidemic.

In the twelfth century, when the strictest rules of quarantine were first inaugurated and were thought to be sure means of confining epidemics in the places where they first originated, the germ cause of the disease was not understood, and the grand principle of disinfectants was not, to any great extent, investigated. The microscope, by which the scientists have gained the ground on which they now stand, had not been discovered by the London apprentice boy. And when we consider the age that anteceded our present era of advance in the sciences it does not appear strange to us that a complete restriction was resorted to when the advance of the cholera or any other epidemic threatened adjacent country or state.

Quarantine undoubtedly was capable of doing all they claimed for it when it was conducted upon the forty-day principle upon which it was constructed; but in this age we must bring into requisition the means that are known to act upon the other wing of our domain of advancement, for it is not consistent with the age in which we live to unnecessarily cripple our commercial prosperity. We are called upon to secure the benefit to both and at the same time to avoid the injury to either; like the chemical union of two bodies to create a new force sufficiently powerful to propel the car of safety over centuries of obstructed accumulation.

The control of small-pox, ship fever, yellow fever and cholera is the object of the quarantine laws and regulations of the United States and is considered under the heads of seaport towns and inland quarantine.

Three out of the four of this formidable quartette of epidemics have been shorn of nearly all of their once undisputed powers. In fact, all of them, except cholera, and the great work has been accomplished by a perserving enforcement of a systematic quarantine—a quarantine instituted and constantly guarded and protected on land and sea. How satisfactory the results have proven, when these laws were strictly regarded, let the records on the medical pages of the three last decades answer. How unsatisfactory has been the result of a loose and careless system of quarantine need not be answered by record or word. It is deeply and painfully engraved on the memory of the survivors of the infested districts. As an example of the lax inland quarantine let us remember the city of Oxford, Miss., I believe in 1876, at which time the inland quarantine was raised long enough to allow the assembling of the state Democratic convention. Although but a short time was devoted to the proceedings of that meeting the rapid spread of the disease revealed the folly of compromising with the deadly foe when it was too late. An example of the results of lax sea quarantine stands out in bold relief in a case where twenty head of cattle shipped to England from a foreign seaport, all developed symptoms of the plague. *But the law was not enforced* by slaying all cattle so infected and the malady was carried to England where 100,000 cattle were lost by the epidemic.

These lessons teach us the importance of enforcing the rules and regulations governing the prevention of disease to the letter, and of carrying out the principles inculcated by past experience with a vigilance and determination on which certainly depends the lives and happiness of the human race.

We are reliably informed that the cholera has advanced to the seaport towns of Europe, and as it has extended its influence thus far beyond the confines of its origin let us endeavor at once, for delay would only add greatly to the danger, to commence our work to confine it by seaport quarantine within the limits of a few leagues from shore, and thus prevent the scourge from crossing the Atlantic ocean.

The proper city or state authorities should procure a large and commodious ship to be used for hospital purposes. For many reasons a floating hospital is preferable to one on land. This vessel should be anchored not less than five miles from the environment of the infected city and well supplied with the very best medical service, including trained nurses, cooks, and attendants. It should also have a full supply of medicines and other necessary supplies.

On board this ship every well marked case of cholera should be transported by means of a tug used for that purpose. The word "cholera" should never be spoken on board the tug or ship without the word "morbus" being attached to it, thus preventing the moral depression caused by the excitement of patients which has been conceded to add greatly to the fatality of the disease.

No drinking water should be used on the ship, until boiled and acidulated with sulphurous acid gas, which should be produced by burning sulphur in the retort and conducting the gas to the water vessels by means of rubber tubing.

The dejections from the patient should be *absorbed by sawdust* and at once consumed by being thrown into the engine furnace in which should be kept a constant fire. The chamber vessels should be immersed in boiling water, after thus disposing of their contents.

The strictest rules of disinfection should be enforced and the hold of the ship should be submitted to an application of superheated steam morning and evening, so as to effectually dispose of all germs that might be lodged there and under the influence of light and warmth be vivified at some future time into active life. All water should be boiled thoroughly before being used by the inmates of the hospital ship and acidulated with sulphureous acid gas. In fact all ships should use this precautionary measure during an epidemic.

The food should be well and properly cooked, and no uncooked vegetables or fruit of any kind permitted to be eaten.

In event of death on board this vessel the body should be disinfected by covering it with clothes saturated in a strong solution of mercury bichloride, the space between the body and case should be packed with ferri sulphus, and the body should be quietly buried at night by the men employed for that purpose. The bedding and all clothing used by the deceased patient ought to be consumed in the ship's furnace.

A receiving ship should be brought into requisition, on which all those who expect to sail for America should be quarantined for nine days.

The same means of disinfection ordered on the hospital ship should be resorted to and rigidly enforced by law on the quarantined ship. All cases

of cholera in any stage of development should be at once removed from the quarantined ship and sent to the floating hospital.

All vessels ready to leave the infected port on the voyage to the United States should be kept in waiting the same length of time as the receiving ship and disinfected in the same manner; this not only while in port, but during the voyage and nine days after arrival in the American port.

Now, Mr. President, I have briefly touched upon the principles of seaport quarantine and my ideas of disinfecting. I have considered the subject on the very surface and shall leave the more careful study in detail to the many good authorities which are at your disposal. I shall now pass on to the land quarantine, in which I rely upon the efficacy of superheated steam as a means of accomplishing in a satisfactory manner the thorough destruction of cholera germs, not only in the railroad carriage, but also in the ship.

The question that presented itself to me when I first began the investigation of a firm conviction was the practicability of the application of superheated steam. The question was soon solved when I was informed by a railroad official that the majority of cars were heated by steam and the heat could readily be supplied by means of the pipes that will heat the woodwork of the coach to such an extent that but little condensation of steam would occur if applied soon after the dry heat was used.

The manner of purifying a railroad coach before leaving the seaport town with its load of human freight is first to heat the coaches with the dry heat, next to turn into each coach superheated steam by opening a stop cock attached to the steam-heating pipes and allowing the steam to remain in the cars for about thirty minutes. The steam should then be turned off and the woodwork, including the floor, wiped dry by means of large sponges wrung out of a strong anti-germastic solution of bicloride of mercury, which drug combines the good principle of being inodorous and very effective.

If these simple means be carried out, I am persuaded that the cholera lion will soon lie down with its associated trio of lambs, and the great and seeming impossible undertaking will have been accomplished by the simple means of turning the river of purity into the yawning cesspool of uncleanness and allowing the swift current of nature's resources to do the rest. (Applause.)

The National Association of Railway Surgeons—Not a Trade Union, but a Philanthropic and Scientific Organization.

[By SURGEON E. R. LEWIS, Kansas City, Mo.]

I feel that I owe an apology for the text selected for this paper, for I know fully well that each active member of this organization never thought for one moment that any one familiar with the aims and objects of a medical or surgical society could question the philanthropic and scien-

tific character of this body of surgeons, second to no surgical organization on the globe. Yet our aims and objects have been questioned by both professional and non-professional men, and this fact is sufficient excuse for a few words upon this subject at the present time.

Many professional men have openly questioned the right of this body of men to form such an association, in the face of the fact of the existence of other organizations of medical men, such as the various state and national bodies, presuming that the ground was covered and only it would be harrowing over and over the already over-worked field, where the producers were many and the product scarce.

But to answer this question I must, in justice to you all, ask you to go back with me to the time, if you please, of old Borhave, who with his followers was content to follow a system embraced in its whole by "keeping the head cool, the feet warm and the bowels open." Up to that time it seems there was need for no other kind of a doctor; but time went on, and the human race multiplying in accordance with a natural law, there came a time of disagreement and the wars which followed produced the surgeon to compete with the mechanical necessities, thus forcing the physician to be also a surgeon, military, if you please, and I suppose our military brethren may claim priority of title, because I am creditably informed that in those days no railway track was yet laid, and as a demand must first exist before the supply can be created, the railway surgeon was not in existence. But the demand has come, and come without periodicity, for the iron horse never ceases to throb and no bugle note must be sounded to arouse him from his slumbers; but ever with us he carries on his mighty work, not only as a great civilizer, but often maiming the hands which bridle him, not as the plowman's horse by a kick or bite, but as the mighty avalanche, crushing, grinding, mangling, the mortal part of employe, owner, passenger or tramp coming in contact with ponderous weight and herculean force. And the recipient of such an injury is the cause for the need of special medical and surgical care—I use the word advisedly—special medical and surgical care, for injuries of this kind, attended by inexperienced surgeons in this special department of surgical injuries, can and must result in a mistaken idea as to the true nature and gravity of the injury, thus doing injustice to the injured and misleading those in control of the operating department of the road.

How many surgeons here to-day can testify to the gravest injuries overlooked by those eminent in their profession in this particular branch of the healing art. I only mention one of many such cases of which I personally was cognizant, in 1875, where in the derailment of an engine the fireman was caught through the thigh between the tender and engine. The skin and bone was not broken, and the strong man when released from this mammoth vice was taken home, examined by an eminent physician and pronounced not seriously hurt. But when examined the second day, by request of the superintendent, it was found that the entire extremity was dead, and the patient succumbed a few hours later. The delay robbed this unfortunate man of every chance, and I venture the belief that no surgeon at all familiar with railway injuries would have even hesitated to at once sacrifice the limb for the life of the patient. I know fully well that one case cannot and should not even suggest a rule, but the frequency with which such cases are met on all large railway lines demands a specially adapted set of experienced men in this line of surgery,

so that lives can be saved and the service inestimably improved. That this service can and shall be improved needs only to be properly presented to the management of any well equipped railway in this country, and I do not doubt for one moment but that every manager needs only to have the facts presented to adopt the only humanitarian plan for best meeting the unavoidable accidents incident to so hazardous an undertaking as rail-roading. Most successful railway managers have grown up from the messenger or water boy, and but few, if any, important necessities have escaped their notice, and they only need to see a remedy in order to adopt it in any department of the service.

My duties as corresponding secretary and then secretary of this association since its organization have brought me in touch with many of the leading railway operators of North America, and to know and realize that many of them have misconceived the objects of this organization has caused me to feel that we as individuals have not sought to present properly our case to those who control every policy of a railway corporation, great or small.

A money consideration is not the first duty of a physician, but a philanthropic feeling must prevail, and if it does not prevail it reduces our calling to a trade level, and it must be looked upon as a trade practiced often by sharks who ignore the first inherent principles of a true physician and lay waste the great field open to our calling.

The railway surgeon owes to his patient the same generous and skillful care whether he be the unfortunate brakeman at the switch, the tramp upon the trucks, the general manager, or the passenger far from his home; and when called upon to administer to the sufferer he should be equipped with the armor of a scientist, for the awful responsibility which rests upon you and at such a time cannot be overestimated.

The old saying "for the want of a nail the shoe was lost, for the want of a shoe the horse was lost, and for the want of a horse the rider was lost," suggests to us that for the want of a proper scientific understanding and a skillful practice our patient is lost. Human life cannot be valued from our standpoint; although our claim agents can tell you to the fraction of a cent what a man's finger, hand, arm leg or life is worth in the market of the courts to-day. Our position, as I conceive it to be, occupies an entirely different ground. We stand midway between the necessary extremes of this case; we have a double duty to perform; the path is straight—an honest representation of facts, regardless of results, must characterize our words and actions, and when we establish such reputations, we must and will acquire the confidence of both extremes, and the mammoth exaggerations often indulged in on both sides will fade from sight, right not might will triumph and equity will decide rather than the sympathy of a jury or the ambrosial curls of the lawyer.

More than fifteen years of experience in railway work has convinced me that all railway corporations desire only to deal fairly and equitably with their injured. That such a result is not always attained, I grant you, but the aggressive policy of both sides, I believe, can be more easily modified and an equitable end reached easier through the benign influence of a philanthropic go-between than through the tribunals of law. And whereas the doctor does not, and should not, act as claim agent, he does and should present the facts upon which a judicious and equitable settlement can be made.

I conceive that it is impossible to eliminate accidents from so hazardous a calling as railroading; yet the surgeon who is called to such accidents should not view the calls as a purely business matter and seek to extort exorbitant fees for his services, for such practices have caused many railway companies to look upon the profession as an association of sharks rather than as a body of scientific and philanthropic men.

To guard against all such contingencies I can see no other solution but that each corporation shall be as necessarily represented by a medical department as by a legal department. I believe the necessities are parallel, and am pleased to be able to say that, in my opinion, the day is not far distant when the majority of stock in each of the many gigantic railway corporations will vote in favor of a properly organized medical department to care for those injured upon their lines, whether passenger, employe or tramp. The willingness of the employes to contribute their share to the necessary expense of such a department has been shown by years of experience on the best equipped and best managed roads in our country, and the results obtained by these corporations are better and more satisfactory to all, as was attested by a recent meeting of claim agents who practically settled the question in favor of a properly organized and properly maintained hospital plan, carrying with it humanity and economy.

DISCUSSION ON DR. LEWIS' PAPER.

Dr. William H. Elliott—This association may be an excursion party, but it is not a trade union. We who have taken part in its discussions here have had little to say in regard to our business and the compensations which we are to receive from the roads for our services. We have left that to be settled between the railroads and the surgeons themselves, because we did not want to make rules and regulations for the settlement of something that did not concern us as an association and which, if we took it up as an association, would only lay us open to the charge of being a money making body. We serve our profession and the railways because we love it. That this body is philanthropic I would be glad to prove by placing upon the witness stand the thousands of those whose lives and limbs we have saved; and for proof that it is a scientific body I would only appeal to the discussion had on this floor and the published proceedings of our meetings. (Applause.)

A Case of Injury to the Bladder and Rectum.

[By SURGEON D. S. FAIRCHILD, Ames, Iowa.]

C., a conductor in the employ of the Chicago & Northwestern Railway, was injured at Moingona, Iowa, March 5, 1891, in the following manner:

C.'s train had been standing on a side track for some time waiting for orders to go—the train was cut for the crossing. The conductor was preparing to start his train and had thrown out the pin as a preliminary to coupling and was between the cars. The engineer at this moment backed up somewhat suddenly to clear a switch and without a signal from the conductor. C., hearing the cars coming back, put his hand on the draft-

iron and jumped into the air, expecting to gain the deadwood and thus escape being caught instead of jumping out from between the cars as he easily could have done. Unfortunately the coupling pin was standing well up, partially held by the link, and C., instead of securing a foothold on the deadwood or draft-iron, came down on the pin which entered his perineum.

C. was brought to Boone as soon as possible, where he was seen by Dr. Deering. The doctor found him suffering from considerable shock, which continued several hours. I saw the man at midnight. Reaction had occurred, but the pulse was decidedly depressed.

The long continued shock indicated an injury more severe than was at first apparent. The patient was placed on his left side and the buttock raised, a lacerated wound two inches in length was discovered. An anesthetic was administered, a catheter introduced into the urethra, and the sterilized index finger introduced into the wound came together. Appreciating the fact that some serious lesion existed no further examination was made at this time and the patient allowed to come from under the influence of ether.

Arrangements were made for a full consideration of the case in the morning.

At 9 a. m., with the assistance of Doctors Deering and De Tar, C. was again etherized and placed in Sims position with the hips extending over the edge of the bed. This position, with the buttock raised, gave an excellent view of the parts. The wound which was about two inches in length as measured upon the perineal surface, and extended from the bulb of the urethra to the rectum was now enlarged by an incision extending to the point of the coccyx. The parts were widely separated by retractors. At first it seemed quite impossible to locate anything, nothing could be seen but a deep ragged channel plowed out by the coupling pin two inches in diameter. Soon, however, the rectum was found retracted or pushed far up in the wound, attached only by a narrow strip of skin, to the anus. This organ, having been located and brought down by a tenaculum, the bladder was looked for. Nothing could be found of the urethra beyond the anterior extremity of the membranous portion. The bladder was finally found pushed very high up with a ragged opening in it about one inch in extent. The posterior surface of the pubis was considerably injured by small fragments being broken or ground off. It appeared that the pin had passed from behind forwards, tearing the tissues extensively in its course, finally striking the pubic bone, breaking off small pieces.

The scrotum, lower portion of the abdomen and the inner surfaces of the thighs were extensively echymosed.

Having located the pelvic organs we now examined the rectum and found that while it had been almost entirely separated from its anal attachment it was not otherwise injured.

After the extension of the wound backwards made by us to obtain light was closed, the rectum was carefully stitched to the external skin except directly in front for the extent of one-half inch, where the tissues were entirely destroyed. A drainage tube was passed into the bladder and brought out in front of the rectum and another tube was introduced to drain the wound itself and both secured by a stitch.

The case progressed favorably until March 18th. On visiting the patient I found that the urine was not discharging freely, in fact for a few days previous to the above mentioned date the urine tended to accumulate and

some effort was necessary to discharge it, and on the 18th he had not passed any urine for several hours. The bladder was full and the patient was suffering much distress. We placed him under ether and examined the wound. The drainage tube no longer entered the bladder nor could we discover any opening into this organ, in fact it was impossible to recognize anything but a large granulating wound two inches in diameter and four or five inches in depth. Efforts were made to enter the bladder through some opening, but after trying with soft catheters and hard catheters and sounds we were obliged to abandon our efforts. We now considered the proposition of making a supra-public cystotomy, but suitable instruments not being at hand, we aspirated the bladder above the pubis and arranged to make the supra-public operation for the purpose of drainage the next day, when we presumed the bladder would be again filled. On the next day, however, we found that the bladder was emptying itself spontaneously at short intervals. Not being able to find an entrance it was quite impossible to pass any fluid into the bladder for the purpose of distending it. We were therefore obliged to wait until nature should again fill the organ. The time did not arrive until March 22d or four days after our first effort. At this time the bladder was fully distended and riding high in the pelvis.

Placing the patient under the influence of ether and assisted by Doctors Deering and De Tar I made a supra-public cystotomy. On reaching the bladder which we did without meeting with the peritoneum the organ was united to the wound by a single stitch. The organ was now opened to the extent of an inch and the urine flowed out. On passing my finger into the bladder the neck was found with a short piece of urethra attached, no other opening was discovered. We had provided ourselves with a rubber tube of the size of No. 17 or 18 English scale. With my finger in the bladder as a guide the tube was passed through the abdominal opening, and into the neck, and on through the attached piece of urethra and finally brought out in front of the rectum which had long before this united to the skin.

We now discovered our difficulty in entering the bladder from below. The prostrate gland had been entirely destroyed, and the inch of urethra still attached to the bladder had retracted and was coiled in such a manner as to prevent the urine from escaping except when the patient was in a favorable position, and if any considerable amount of urine accumulated, as during sleep, the organ would ride above the pubis, and any effort with the neck resting on the pubis only increased the difficulty, and the difficulty of passing a catheter into the lower end of the urethra with the organ in this position became obvious. The passing of the tube from above downward straightened the urethra over it smoothly. Four openings were made in the tube where it rested in the bladder. The tube was secured both above and below by means of safety pins. A short drainage tube was placed between the pubis and abdominal wall to prevent infiltration and the wound lightly packed with iodoform gauze.

The patient reacted well from the operation and passed along without further trouble, various expedients being resorted to to prevent or lessen the soiling the bed, until April 12th, or three weeks after opening the bladder. We now believed that the attached piece of urethra had contracted firm adhesions to the surrounding parts and that therefore communication should be established with the bladder through the urethra. To accomplish this it was necessary to pass a soft catheter through the urethral canal in the penis and from this into the short portion of urethra attached to the bladder. This did not appear to be an easy thing to do on account

of the entire absence of any urethral canal; commencing near the beginning of the membranous portion and extending back to the above mentioned piece, a distance of two and one-half inches. In order to make sure of our connections the tube extending through the supra-pubic opening and out through the perineal opening was brought down far enough to cut off just above where it had been resting in the perineal wound and secured by a pair of catch-forceps, it was now cut at a point where none of the tube which had been exposed to the chances of infection would be thrown into the bladder. A soft catheter, the largest the urethra would carry, was now passed through the urethral canal in the penis and caught by a pair forceps where it emerged into the perineal wound and brought out through the perineal opening, which had at this time been reduced by granulation to the size of the finger. The end of the catheter was introduced into the end of the larger tube still remaining in the bladder and secured by a stitch. The wound including the united ends of the catheter and tube was thoroughly irrigated with a four per cent solution of boric acid, and the larger tube protruding from the supra-pubic opening thrown out, bringing the catheter with it into the bladder. The stitch was cut and the tube separated from the catheter, a strong silk thread passed through the eye of the catheter and the catheter dropped into the bladder and the thread secured outside by tying it over a roll of iodoform gauze. The catheter was allowed to remain in this position. The urine discharged through the catheter or through the supra-pubic opening according to the position of the patient. The supra-pubic wound was dressed with iodoform gauze and absorbent cotton changed as often as it became soiled, and the perineal wound irrigated with boric acid and lightly packed with iodoform gauze.

Granulation rapidly filled the supra-pubic and perineal wounds, and as soon as we became convinced that a catheter would follow the old and new canals all the way into the bladder, which was about the middle of June, the thread securing the catheter was cut and the catheter removed. The minute supra-pubic opening rapidly closed securely.

A catheter was passed at first several times a day. This was found necessary in order to empty the bladder, but in a short time the patient found no difficulty in passing his urine unaided. After the catheter was dispensed with a steel sound was passed once or twice a week for the purpose of preventing the formation of a stricture.

The patient found that on urinating a small quantity of urine escaped through a perineal fistulae communicating with the urethra at the junction of the natural portion with the new formed portion, i. e., about one and one-half inches from the neck of the bladder. This condition appeared to be due to the fact that the urine was delivered to the new formed section of urethra faster than it could be carried off and the pressure at this point was sufficient to maintain a fistula. This view seemed supported by the fact that the section of the old urethra connected with the bladder still maintained its distensibility, while the new formed section being composed of cicatricial tissue maintained a rigid condition and allowed the urine to pass in a somewhat reduced stream.

This condition was a source of considerable annoyance for several months, rendering it necessary to take down his clothes in the act of urinating. Contraction gradually occurred and the quantity of fluid passing in this manner grew less and at the present time only a few drops escape obviating this inconvenience.

The man is now enjoying excellent health, and in September, 1892, resumed his employment as a freight conductor and gets along very comfortably. On account of a lack of confidence in his strength his work for some weeks was somewhat irregular.

DISCUSSION ON DR. FAIRCHILD'S PAPER.

Dr. H. H. Middlekamp—Gentlemen of the Convention: Dr. Fairchild has detailed to us a very interesting case, and I do not know that I can add anything to his remarks. His plan seem to have been to render the wound aseptic, drain it and pursue a conservative course; his attempt being to render the urethra patulous. That was the only thing that could be done. It is supposed that drainage is the most important point in the treatment of bladder wounds; and if it cannot be accomplished in any other way supra-public cystotomy is to be performed. I think, however, that if the doctor had introduced the catheter from the urethra into the wound at once and made the attachment immediately after the operation of supra-public cystotomy had been performed, he would have hastened his cure. Perhaps it would have been better had they performed that operation at once. In the old operation for stone in the bladder, the low operation, I believe that almost invariably the bladder was allowed to heal without any stitches. As to this point, in supra-public cystotomy and wounds of the bladder, surgeons seem to be divided, some advocating that the wounds in the bladder be stitched, while others oppose the method. It seems to me if there was any wound at the fundus, or base, of the bladder, somewhat posterior, supra-public cystotomy ought to be performed, the bladder wound brought together and drainage tubes inserted through the urethra and the external wound so that healing could be brought about.

These, it seems to me, are very serious cases, and I congratulate Dr. Fairchild upon his success in saving the man's life. Such wounds are very rare, and the operations upon the bladder for wounds of that organ have not been very numerous. The questions arising in these cases have not been satisfactorily decided—at least, surgeons are divided in their opinions concerning them. I noticed, in reading the text book of American Surgery, by Keene and White, that they advocate, as the consensus of opinion of those who have aided in preparing their work, pursuing a rather conservative course, if I remember right; while others maintain that the bladder wound should be sutured at once, but that externally there should be an opening of sufficient size through which to drain the urine from the bladder. (Applause.)

Dr. Griswold, Sharon, Pa.—Mr. President, Ladies and Gentlemen in Convention Assembled. This case is one of extreme interest. It is somewhat unique. It is very rare, in civil practice, to find an injury of the kind described in the paper just read by Dr. Fairchild. In fact, in any practice it is extremely rare. Hardly any criticism, I think, can be made in reference to the method of treatment pursued by the reader of the paper, who showed consummate judgment and extraordinary skill in its management. Conservatism, gentlemen, did not dictate to him the necessity of performing supra-public cystotomy until the patient was unable to discharge the urine from the bladder; but when he did do that operation he performed it thoroughly, and the result was most excellent. This case shows the reactionary powers of nature in a certain class of cases. The

doctor does not say how old the patient was, nor does he say whether he had any diathesis, or whether there was any constitutional taint. The result, however, shows that he was probably young, and that there was no constitutional taint to prevent reaction and recuperation.

I have never seen a case exactly like the doctor's in civil practice, although I have been practicing a long time. In military practice I have had some few cases of a somewhat similar nature—one particularly which extended over a much longer period of time in its treatment than this case has yet reached. The patient was shot directly above the pubic bone, the ball entering directly above and making its exit at the junction of the sacrum with the left os innominatum, perforating the bladder and the rectum. Discharges came from both openings, anteriorly and posteriorly, faecal and urinous. The patient dragged along for very many months. The treatment that we knew of at that time was very different from what we have now. We were not then antiseptic or aseptic; we did not take the precautions that we take now, and I can look back, I may say by way of digression, and see many cases in which, if aseptic surgery could have been practiced, lives could have been saved. Future military surgery will be vastly different from that practiced in the past.

I am sorry the Doctor does not state anything further. I would like to ask him about the prostrate gland; whether it was totally and entirely destroyed.

Dr. Fairchild—The new urethra was formed without any prostrate gland.

Dr. Griswold—That, of course, makes a great difference in regard to his future. If he is an old man it does not make much difference; but if he is a young man it makes a very considerable difference as all surgeons know.

Dr. J. B. Murdock—I consider this a very interesting case, and I think our young friend, Dr. Fairchild, is to be complimented on the skill with which he treated the case. Dr. Griswold has referred to it as an exemplification of the wonderful recuperative powers in nature. It is something more. It is a wonderful exemplification of the powers of skill and science, for without that the patient would have been lost. I know of no more difficult cases to manage than these. I have never seen an exactly similar case, but have seen a good many cases of rupture of the urethra. This was a rupture of the urethra and something more. I have nothing to say especially about it, only that to have found the urethra and to have performed urethrotomy without any guide (which he would not have had) to the bladder would have necessitated a great deal of trouble, and the doctor in letting it alone for that night did all that probably could have been done; and when he resorted to supra-pubic cystotomy it seems to me he did what was the right thing, and the result shows it. It is an operation that should be performed oftener than it is, in my opinion, in cases of ruptured urethra. This man is recovering and is now passing his urine naturally as the doctor tells us; but it is a case which will have to be watched, because there is a portion of the urethra that is made up of cicatricial tissue which will be liable to contract; in which case he must pass the catheter during the remainder of his life. But this young doctor has done all that could have been done by the most skillful surgeon in the case, and I compliment him very highly upon the manner in which he managed it.

Dr. Newton—I wish also to congratulate the doctor upon his treatment of this case. I think it is a triumph for antiseptic surgery; for without

antiseptics that man would surely have died. We all know the old rule of surgery that injury of the bladder of that nature was fatal. I believe all the older surgeons here will back me up in that statement. The result of this case shows good surgical skill. Speaking of the bladder, there is one point I wish to bring out; which is, that wounds of the bladder are exceedingly indolent in recovery. That is a rule laid down very strongly in Otis' Medical and Surgical History of the war, in which he speaks of gunshot wounds and injuries of the bladder as being exceedingly indolent.

Dr. Newton then detailed a case of a woman who had been under his care for a pistol shot wound, the bullet entering the abdomen, passing between the bladder and rectum. The track of the bullet was through the cul de sac of Douglas, passing through the lower part of the vagina. The woman recovered after three months' treatment.

Dr. Jesse Hawes, Colorado—One surgeon here states that without the use of antiseptics the case reported by Dr. Fairchild would surely have proved fatal. The doctor is spoken of as "the young doctor." I believe it must be fortunate for these cases sometimes to fall into the hands of the young doctors; for when I was practicing medicine about thirty years ago an almost identically similar case fell into my hands. I am not able to give you all the points in regard to the case (it was never reported); but certain it is that the case seemed to be doing well enough under the "let alone" policy. There was an opening, due to the boy falling upon a hoe handle, passing through the rectum and into the bladder and retained as long as we deemed necessary. Within a few weeks nature cured up the wound, and in less than a year the boy was as well as he ever was. (Applause.)

Dr. O'Brien, Pennsylvania—I wish to report a case somewhat similar to that reported by the last speaker: I was called in consultation to see a case in which it was said rupture of the bladder had occurred, owing to a car having been backed up on a patient while he held and moved it with a pinch bar. The attending physician attempted to pass a catheter and found that it moved freely upon the pubis. He, therefore, concluded he had a rupture of the bladder. I soon satisfied myself that that was not the case; that the bladder could be found above the pubis. Fracture of the pelvis had occurred. The ascending ramus of the ischium had been fractured, and I could feel the loose fragments. Not being prepared to do a cystotomy I simply inserted a trocar into the bladder above the pubis, and on the following morning opened the bladder from below; the patient, of course, still remaining in a condition of shock. I can testify to the extreme difficulty of finding the true fragments of the urethra. They were separated for a considerable distance. The urethra had been caught upon the edge of the pubic bone and completely severed. I opened the bladder in the prevesical space, inserted a large-sized drainage tube, and allowed the bladder to drain in that way for several days. The loose fragments of bone (comminuted fracture) set up an abscess of the perinaeum; and an abscess pointed upon the thigh, which I afterwards opened. Ultimately I persuaded this patient to go to the hospital and place himself under Dr. R. W. Stewart, who did a supra-public cystotomy. The patient has made an excellent recovery, with the single exception that he has imperfect motion of the left hip joint, due to the fracture of the pelvis. (Applause.)

The Responsibility of the Surgeon.

[By SURGEON C. M. WOODWARD, Tecumseh, Mich.]

It would seem that this subject should be relegated to the attorney instead of the surgeon, but, as this will be considered solely from a surgical standpoint, avoiding legal questions, it will, perhaps, not seem improper to deal thus with the subject. The responsibility of the surgeon begins when he first assumes charge of an injured person, whether he be employe or not, and does not end until the case is brought to as successful an issue as is possible, so far as the surgical aspects are concerned. The responsibility, then, rests in the scientific management of all cases coming under the surgeon's care, and this presupposes a competent one, well versed in his science and art, and diligent and careful in fulfilling every indication, that nothing shall go unnoticed; and the exercise of judicious skill, that every advantage which presents itself for the patient's physical welfare shall be embraced. The surgeon should not only be well versed in the latest and most advanced literature of his science, as to operations that may be necessary to perform, but as well in the subsequent treatment according to the most approved methods, and in the use of antiseptics best adapted to each particular case.

The best judgment as to the nature of an injury and the nature and extent of the operations required must be made quickly and firmly, and acted upon in the same manner, if one would bring the greatest surgical success to the case, with a consequent good feeling on the part of the patient.

It may seem peurile to mention the matter of "antiseptics," and careful and scientific surgical attention, to a body of surgeons having the scientific attainments of those here convened; but it may have fallen to the lot of many of you in the past, as it has to the writer, to observe a fearful lack of knowledge of these important matters by some who have attempted to fill the position of railway surgeon, whether they were regularly appointed or not, or, if that knowledge was possessed, there has been an unaccountable lack of a display of such knowledge. It is perhaps unnecessary to particularize, as many cases must have fallen under your notice. Surgeons (so called) who do not believe in antiseptic surgery and the use of antiseptics still exist, although we trust there are few or none who bear the name of "railway surgeon" who are afflicted with this mental aberration.

Now, if a surgeon, lacking the essential qualities of a surgeon, shall have charge of a severe case of railway injury, in all probability the case will not "do well," the cure will be delayed, the patient's sufferings will be increased and prolonged, from which he naturally seeks some kind of relief, and if he does not quickly secure relief from his physical sufferings and deformities by skillful surgical treatment he immediately turns his attention to the railway company for substantial relief, in a suit for damages for the largest possible amount. The nervous unrest and dissatisfaction begotten of the unskillful treatment by his surgeon has largely provoked him to this course, in which he is sustained by his friends, and trouble and expense to the company is the result. Had his injuries been treated after the most approved methods and a cure quickly effected, this nervous and mental unrest would have been quieted, and there would not



have been the same incentive to the development of the suit for damages; yet still, if the suit is instituted, it is ordinarily not prosecuted with the same vigor. Some have said that it is not the surgeon's duty to protect the company whom he serves. If it were to act as a spy or to employ questionable means to obtain a settlement between company and patient, acting in the capacity of a "claim agent," then he is going out of his sphere, and it is not his duty to protect his company in this way. But when the consideration is given to the employment of the best medical and surgical skill and treatment known to science, then it is his imperative duty to protect his company in this manner. The surgeon, then, stands in the same relative position to the railway company that the medical examiner does to the life insurance company—he is the natural protector of the company's interest by his skill and scientific management of his cases. If, on the other hand, the surgeon (unfortunately for the company) is incompetent, he greatly endangers his company in a greater liability of suits for damages, becoming thereby directly or indirectly responsible, which liability a competent and successful surgeon might have averted. Illustrating this subject, we may turn our attention to the famous \$32,000 case, which is fresh in the minds of all, and photographs of the different aspects of the case may now be exhibited. In this case the patient had his foot caught between the rail and plank at a public crossing, and was run down by a fast mail train, having one leg crushed just above the ankle (the left) and the other (the right) crushed across the center of the foot. An "irregular" and non-graduate surgeon was called. This non-graduate operated, assisted by the company's surgeon, who gave the anaesthetic, one leg was removed just below the middle third, the other in front of the ankle joint, where, as the writer was creditably informed, there was originally a fine opportunity for a successful "Symes" or "Pirogoffs" operation, which would thereby have left a very useful leg, with the heel to step on, avoiding the necessity for an artificial leg. If this information was true, the opportunity was not embraced, but a flap was made from the inner aspect of the foot, bringing it around to the outer side, and there stitching it. This left the tibia and fibula, with a portion of the articulating surfaces projecting, while the heel, containing the "triangular space," projected downward and backwards. After the operation, this surgeon left a Petit's Tourniquet around each thigh near the groin, screwed down tight, for four consecutive days, before they were loosened or removed. On the morning of the fifth day gangrene of the stump of the left leg began and continued until every portion of the flap had sloughed far above the point of section of bone, leaving the tibia and fibula protruding for about two and one-half inches, like the tusks of an elephant. On the twelfth day the writer was called by telegraph to make a reamputation of this stump, which was done just below the knee, removing entire the remaining portion of the fibula. The patient made a good recovery from this secondary amputation, although considerable trouble was encountered from inflammation and suppuration in the muscles of the thigh, from just below where the tourniquet encircled it to the knee, necessitating the introduction of drainage tubes and thorough irrigations and washing out of the sinuses with antiseptics. Still the patient suffered in some degree with pyaemia and septicaemia. History informs us that when the tourniquets were removed, on the fourth day, they had cut into the flesh so that the straps were nearly hidden, the marks of which are plainly visible to the present day, now more than two and a half years since the occurrence. At the end of one year and two months the writer was again summoned to make a reamputation of the other leg.

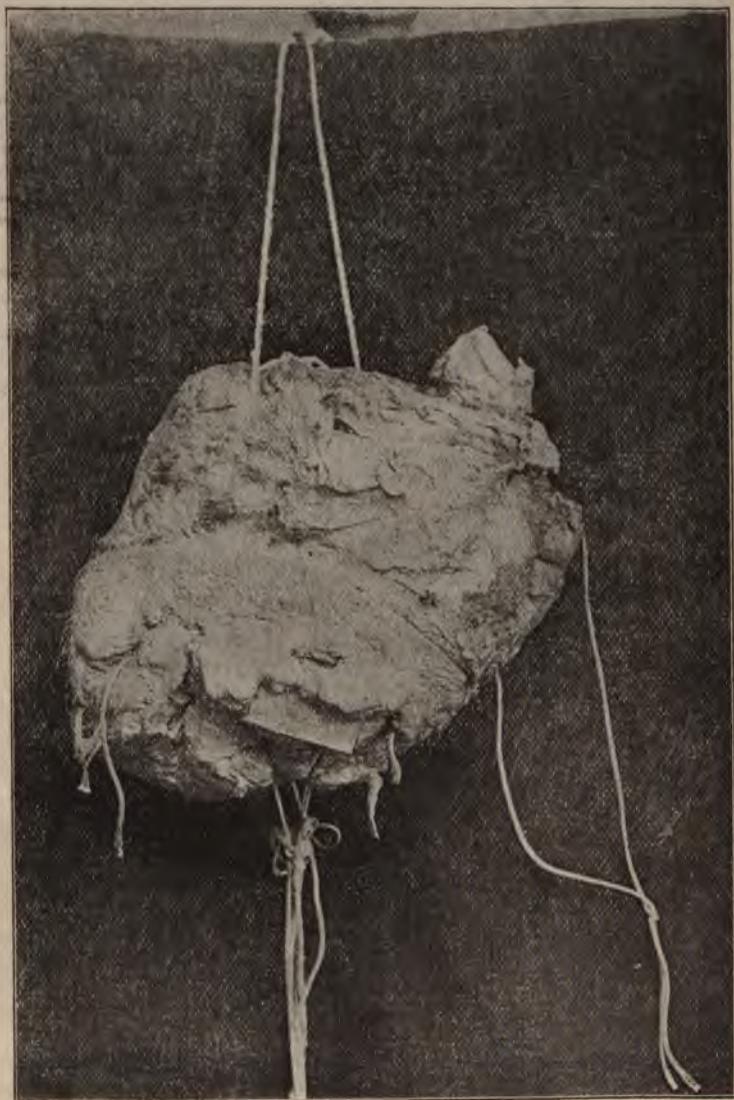


on account of the strong contractions of the tendo-achillas drawing the astragalus and os calcis forcibly backward and driving the heads of the tibia and fibula still farther through the opening, which had never perfectly healed. The head of the bones had now become blackened by exposure. The forcible contractions of the tendo-achillas was productive of great pain, which was having a bad effect on the patient's health and endurance. The patient recovered nicely from this, his fourth, amputation, sat up on the tenth day, was able to be up considerable at the end of the second week, and was perfectly recovered by the end of the third week. But, although he recovered his physical health after over two years of suffering, that "nervous unrest" and "dissatisfaction" spoken of did not subside, until a suit for damages had been instituted against the railway company and won by the patient, for the amount allowed by the jury at the first trial of the case, for \$32,000, which was subsequently paid over by the railway company.

Did any responsibility attach to the surgeon who first operated in this case? Was not the leaving of a tourniquet on each leg or thigh near the groin, screwed down tight for four days, accompanied by a fearful responsibility to the surgeon who permitted it, and through him reacting on the company whom he served? Also the sacrifice of a leg with a heel which might have been saved to a degree of usefulness by a proper operation at the time of the accident? This opportunity, however, being neglected through lack of skill or interest, the leg was lost; hence, due largely to these circumstances, this large verdict by the jury was given. Therefore, in the skill, or lack of skill, which the surgeon possesses, lies his responsibility, so far as his relations to his company are concerned, in suits for damages. He must be truthful and the soul of honor, but giving no evidence, so far as the attorneys are concerned, either for or against the company previous to a trial. His mission is to perform his surgical duties in a thoroughly scientific manner, and secure the best results obtainable in the shortest possible time.

His work should speak for itself, and that only. If called upon the "stand" to testify in any case, the plain, unvarnished truth should be told, in plain, unmistakable language—nothing concealed, nothing distorted or evaded—and, although the surgeon is never held directly responsible for the result in any case, especially in regard to the "damage" question, yet there is an unwritten and moral responsibility from which he cannot escape, and a responsibility which he owes to his company to accept, in that he assumes the important responsibility of performing his duties as a surgeon in the most approved and scientific manner, and of obtaining the best results possible under the circumstances with as little delay as the case will admit. The best interests of railway companies will be subserved by carefulness to employ only the best surgeons, and in organizing a surgical staff, for each road or combination of roads, each system having a "chief surgeon," whose duty should be not only to secure the services of the best surgeons as members of his staff upon all occasions—and such occasions are always those of emergency—while such rules should be adopted and instructions given as would insure the perfect and complete preparation of each surgeon to respond to an emergency call at a moment's notice, day or night. It is only by such organized and systematized service that the best interests of the companies can be subserved.

Referring to the transportation of the injured, and with a view of aiding the surgeon in his important duties, each company could easily arrange



two cars on its lines as "hospital cars," supplied with all the necessary appliances and conveniences of a miniature hospital. One hospital car could be held at each end of the route, which could soon be sent to the scene of an accident, if severe, where the injured can be comfortably and properly cared for and treated, or any operations performed at this movable or "field hospital," and the patient or patients finally safely transported to a base or principal hospital, wherever that may be established, the hospital car serving as the "field hospital" and ambulance combined. Some of our members have already devised very admirable models of such cars, and cars similar to these can be easily arranged from an ordinary car, with but very little expense to any company. By thus furnishing to surgeons the means of properly caring for the injured, and an opportunity of using all the skill of which they are possessed, the responsibilities of both company and surgeons are lessened, with a corresponding lessening of the liability of suits for damages, saving many thousands of dollars to the companies throughout the United States each year, and be of untold benefit to the injured and suffering. The amount of money recently paid by a railway company in settlement of one suit for damages (\$32,000) would have been sufficient to fit up in a very creditable manner sixty hospital cars, transformed from some of the rolling stock of the road, which cars, when put to the uses for which they were designated, would, in time, save to the companies more than twenty times their cost in money value and be of inestimable value to humanity.

It is believed that sufficient money is paid out annually by the railway companies of the United States in settlement of suits for damages to put into complete and perfect operation a thoroughly organized and equipped surgical department on all lines, with a reduction of the annual expenses for such suits, fully 75 per cent.

The very fine views furnished from the war department, surgeon general's office, show very nicely the appearance of the stumps, at the time of the reamputations made by the writer. These specimens are now preserved in the Army Medical Museum. It may be noticed in one, not only how the gangrene ate away the flaps, but also the size of the cord and number used as ligatures for the arteries. We do not know under what adverse circumstances the doctor labored at the time of the primary operations, but sufficient is learned by examination of the views to prove the necessity of surgeons being better prepared with suitable material and appliances for meeting the indications in every case that may come under their care.

Railway Surgery in Law and Medicine.

[By CLARK BELL, Esq., New York City.]

President American International Medico-Legal Congress.

When we speak of American railways we embrace all in the Western hemisphere. Those of North America exceed in mileage all those of the other nations of the civilized world.

The Dominion of Canada had completed and in operation 14,000 miles of railways. In the same year the United States had 214,000 miles, including double tracks and sidings. The ratio of increase in mileage in the near

future of new lines now contemplated or in process of construction will probably be as great in proportion for the American Union as is its present preponderance over all other countries combined.

Every railway should have its surgeon. He is a necessity as much as its lawyer, its president or even its superintendent. Both professions of law and medicine are now a necessity for the proper management and conduct of a railway.

The railway surgeon came perhaps last, but he has come to stay, and no railway of importance can now dispense with this officer. The great importance to the railways themselves of a capable surgeon has more recently come into universal recognition, and the general public, for whose convenience, use and welfare railways are constructed and operated, has an enormous stake in the capacity, the integrity and the ability of the railway surgeon.

Whatever may be said or thought of the practice of medicine as a profession, all concede that surgery is a science—an exact science—and that railway surgery should and must keep pace with that marvelous advance made in surgical science during the past quarter of a century.

In the nature of things and from the necessities of the situation it is not enough that a railway surgeon should be abreast with the advance of surgical science. He should—I had almost said he must—be educated in those branches of the law which impinge upon his duties and the exact relations of the railway to those who suffer injuries and come under his hands.

The capable railway surgeon of to-day should be a medico-legal jurist in a more complete and much larger sense than has been ever considered before. He should familiarize himself with the principles of law bearing upon all questions of liability and responsibility on the part of the railway company for injuries in all classes of damage cases, and ignorance or want of intelligent appreciation of the facts in such cases are frequently of substantial damage and injury to his company.

The same necessity in a like degree attaches to the completely equipped railway lawyer. It is not enough that he thoroughly understands the law applicable to a given case, he is a thousand-fold better qualified for his trial, if he has mastered the surgical questions involved, and it often becomes the most important duty of the railway surgeon to carefully and patiently instruct counsel in the surgical minutia of a case without which the latter would be almost incompetent to try the action, no matter how able, or well grounded he was, in the law of the case.

To-day the railway counsel in damage cases for personal injuries should be also a medico-legal jurist in the best sense, and while the surgeon will regard the issues from surgical standpoints and the counsel from legal; it is by the intelligent combination of these two professions that the elucidation of the questions at issue are safer in such hands both for the railways and the public.

For example can anything be more important to the railway surgeon than to know precisely what the rule of law is, regarding the settlement of claims for damages on behalf of the railway with persons injured, and just what his duties are in that regard.

Lord Chief Justice Coleridge said from the English bench only last February in the case of *Smith vs. South Eastern Railway Company*, referring to the action of a railway surgeon who had been acting for his company in endeavoring to compromise a claim with the injured man, to

whom he had submitted various offers for settlement. "Anything more improper than what was done by the company's medical officer—I mean making offers of various sums to the plaintiff—I never heard. I thought all the great railway companies had given up the practice—medical men huckstering with the parties injured—as to the amount of damages," and he refused an application for a new trial where £850 had been awarded merely on the ground of the misconduct of the medical officer.

There may be railway surgeons who do not know how the law looks upon such transactions, and there may be railway officials who do not suppose that they prejudice their cases before the courts by consenting to or instructing their surgeons to make an effort to compromise their accident cases.

Again it is important a railway surgeon knows exactly what his legal rights as a witness are, when upon the stand giving evidence in a damage case. The value of his own evidence, and the rights of his principals may turn on his sustaining himself as a witness and properly resisting and resenting improper and illegal encroachments of counsel upon the legal rights of a witness.

Again. Take the recent exciting trial of Dr. Buchanan in the City of New York and consider the great advantage which the defendant's counsel in that case had by reason of the extraordinary knowledge they had upon the especial subject of inquiry by reason of the education they had acquired upon the medico-legal points involved and the especial training of Mr. O'Sullivan in that class of cases who aided the veteran and skilled counsel for the defense Mr. Brooks.

This special knowledge so useful, so essential, so necessary to each profession to the lawyer as well as the surgeon cannot as a rule be obtained in the schools of either medicine or law as now administered.

It is not taught there with a few praiseworthy exceptions, and the ablest men of both professions confronted by the exigences constantly arising in railway practice have been compelled to learn what has thus far been acquired often in the bitter school of experience and some times at a high cost to railway or sufferer.

My purpose is to induce you to examine how these questions can best be met. How can the railway surgeon best fit himself for duties, and how can railway counsel best qualify themselves for the emergencies constantly arising requiring superior and technical knowledge and skill?

The National Associations of American Railway Surgeons exists to-day because of the crying want. It is your *raison d'être*. Your work careful analyzed is an effort on the part of the individual surgeon, spurred on by the necessities of his environment to seek additional knowledge by inquiry of and contact with his fellows.

This is a step in the right direction, and justifies a wonder that it has not earlier found that recognition which the great interest aroused by the labor of this body has excited in the railway world. It has been and will be fruitful of good, but it does not go as far as the intelligent surgeon desires and indeed must advance. It has stimulated and quickened the expansion and extension of surgical inquiry, knowledge and research, but the surgeon needs also the same careful education in legal knowledge to qualify him that the lawyer does in the surgical knowledge so important to the proper discharge of his duty. It is the contact of the two professions of the lawyer and the surgeon upon the same general lines of study to which

I deem it an honor and my duty to urge your thoughtful attention, in the hope that it will also reach the brighter minds of my own profession.

It was to meet a similar position in relation to the professions of law and medicine that the Medico-Legal society was founded more than twenty years ago, and to which since I assumed the chair of that society in 1874 I have given some of the best years and most careful studies of my life. That society, originally local and confined to the city of New York, has long since become national and even international in its autonomy and work.

It has vice presidents and active members in nearly every state and territory of the American Union not only, but in many foreign countries, and students of forensic medicine in all the great capitals and the chief cities of the world are upon its active, its corresponding and its honorary list

Its initiation fee is \$5 and its annual dues only \$2 (outside of the State of New York), entitles each member to the Medico-Legal Journal free—paid for by the society—and the society and its journals, now just completing its tenth volume, have advanced the study of forensic medicine in a most conspicuous and successful way throughout the world of medical jurisprudence.

That journal has recently opened a department of railway surgery, which will receive the aid of some of the more prominent railway surgeons of the country, and to which also eminent railway lawyers will contribute editorially; and this department of its columns will be devoted to the study of those issues and questions so full of interest to both lawyers and surgeons in railway cases.

I venture to make the following recommendations which I hope also will interest railway counsel as well:

First—That a section upon railway surgery be formed in that society under a general chairmanship to be annually chosen with a board of vice chairmen, composed of lawyers and railway surgeons, selected from various sections of the country.

Second—That the admission fee of the section be fixed at a nominal price, say \$5, and the annual subscription or dues be fixed at \$2, entitling each member to the Medico-Legal journal free, and that the section be devoted under the joint management of able men of both professions to the study of the subjects we are considering the advancement of railway surgery in its best and broadest sense, and that contributions from both professions be solicited and utilized in its columns.

I would suggest that a joint committee of conference be named by this body to meet a like committee of the Medico-Legal society, with power to agree upon a plan and basis of organization and upon the personale of the officers for the first year, to consist of a chairman and ten or more vice chairmen from each profession, who would take an interest in the subject, and that the members of your body and of the Medico-Legal society be urged to unite with the section and help to advance its work and in all ways increase its usefulness.

If even one hundred men from each profession would thus unite in a section work of this kind, and the medical and legal press aided the endeavor, it would be the most notable forward and upward step in railway surgery of our century, and would certainly be conducive of **great good** toward the advancement of forensic medicine in the interesting and very important department of railway surgery.

The Medico-Legal society has on its roll of members some notable names among railway surgeons, among whom I mention, without intending to be invidious, Dr. G. P. Conn of New Hampshire, Dr. Nicholas Senn of Chicago, Dr. Eads of Texas, Dr. Nunn of Georgia among surgeons; and among railway jurists, Judge John F. Dillon of New York, Chief Justice John C. Allen of New Brunswick, Chief Justice Horton of Kansas, Judge L. E. Emery of Maine, Judge Strahan of Oregon, Judge A. E. L. Palmer of New Brunswick, Judges McClellan and Coleman, of the supreme court of Alabama, besides its president, Judge Abram H. Dailey of Brooklyn, and its ex-president and now first vice president, ex-Judge Henderson N. Somerville, late of the supreme bench of Alabama.

While acting on my own responsibility and without time for consultation among my associates in the Medico-Legal society, I feel safe in saying that the proposed movement is so in line of sympathy with the work of that body in the past in similar directions that I will guarantee its hearty co-operation in such a movement if it meets the approval of this organization.

Bandage for Fractured Clavicle.

[By SURGEON J. T. FIELD, Fort Worth, Tex.]

Several years ago I assisted in reducing an ancient dislocation of the shoulder joint. The head of the bone had become fixed, and there were strong adhesions which confined it in its faulty position.

Under anaesthesia, and after laborious manipulation, the adhesions were finally broken up, and the head of the humerus replaced in the glenoid cavity, but when the force which was required to replace the bone was removed it would immediately return to its former position.

Remembering a lecture made by Prof. Sayre twenty years ago, in which he said "if a surgeon would overcome a deformity and relieve the patient of pain by the use of his hands, and did not have the requisite amount of skill to adjust an appliance that would do the same, it was the surgeon's duty to continue to make use of his hands until the patient recovered." That being a greater undertaking than any of us desired to enter upon, I called for a bandage six inches wide and four feet long; catching it in the center, applied it to the patient's elbow; after flexing the arm, and carrying it to the front, so the end of the fingers rested on the opposite shoulder joint, then bring the bandage obliquely upward, over back and front, it was securely fastened by means of safety pins over the shoulder; splitting the bandage over the confined hand, it was liberated; then adjusting and pinning the bandage about the elbow, and also pinning another bandage two inches wide to the one in front of the elbow, and bringing it around the body and securing it like a belt, I found that the bone was comfortably retained in its position.

Noticing that the injured shoulder was forced upwards, outwards and backwards, I saw that I had a bandage for treating fracture of the clavicle.

Now, for a fractured clavicle (which I had heretofore dreaded and heartily wished that I should never see again).

I soon had a patient who had been wearing several appliances for seven days, and who had about abandoned all of them, except a sling, stating that the things all cut and hurt him; moreover, they did him no good; hence, he would not wear them. After adjusting the bandage as seen in

figures Nos. 1 and 2, he stated that it was comfortable and that he could wear it; which he did, and secured a favorable result, with very little deformity.

The bandage consists of a shoulder piece made to fit the convexity of the shoulder, with five anterior and posterior straps; an arm piece is made to fit the convexity of the flexed elbow, and long enough for each end to reach the shoulder piece, and has five buckles to receive the straps of the shoulder band. These bandages should be of good, strong material, and from four to eight inches wide—owing to the size of the patient. A belt of the same cloth one inch wide and long enough to encircle the body, with a buckle attached to one end, is fastened to the bandage over the elbow. By tightening this belt, the elbow can be forced against the side of the body,



FIGURE 1.



FIGURE 2.

thereby assisting in forcing the shoulder outwards. Another strap is attached to the bandage under the hand, passed under the axilla and buckled to the bandage just under the shoulder (see figure No. 2), which completes the bandage.

If, after the bandage is applied, one of the fractured ends is found to be displaced upwards (which, however, rarely occurs), the "clavicle depresser" of Dr. Jesse Hawes could be used; or, what I have found efficient, two pieces of fan-shaped plaster one inch at one end and four to six inches at the other—say, seven or eight inches in length; to the small end of each attach one end of a piece of elastic webbing; depress and approximate the fractured ends place a sufficient compress of cotton, or gauze, over the elevated end of the fracture, and fasten the plaster to the

anterior and posterior surface of chest, drawing the elastic webbing sufficiently tight to hold the same in place. The compress can then be increased or diminished as required, to keep the fracture properly adjusted.

A few months ago a lad of fifteen or sixteen years of age was thrown from his horse in front of my residence; he was picked up in an unconscious condition, but was soon restored to consciousness. I found that he had sustained a fracture of the left clavicle. Looking around for something with which to make a temporary dressing, that he might be able to return home and receive the attention of his own family physician, my cook brought me a nice, clean, soft tea towel, about one yard square, which I divided into two parts and had the ends sewed together, removing the boy's coat, adjusted the fracture and applied the bandage, as in case of dislocated shoulder. The lad mounted his horse, expressed himself as feeling very well, and rode off. A week or two later I met the lad; he was still wearing the bandage made from the tea towel; it had not been removed since placed there by me; he had not reported to his family physician, as his fracture had given him no trouble and he did not think it was necessary.

Amputations.

[By SURGEON JOHN VAN DUYN, Syracuse, N. Y.]

In railway surgery the frequent occurrence of amputation in an extremity invites criticism of the prevailing methods.

The principles which control the judgment in determining the necessity of the operation and the general rules of its performance are not in question.

Assent is universal that the operation should be performed with strictest cleanliness, to avoid infection and inflammation; that the flaps should be so formed that the cicatrix of repair may not be pressed upon injuriously by the artificial appliance; that the bone be sawed with a steady motion in one direction and not splintered, to avoid subsequent inflammation and necrosis; that the arteries should be ligated so as only to effect closure of the lumen of the vessel, and not lacerate its walls; that all nerves be drawn out and cut short, so as to avoid painful stump from enclosure of the nerve in the cicatrix, the formation of neuromata and neuritis; that the tendons should be cut short, thereby avoiding their necrosis; that drainage tubes be so placed that all possible spaces may be effectually drained; that the flaps be so fashioned as to secure perfect coaptation; that the length of the stump be left as great as possible, so as to furnish the best support for the artificial appliance.

It is not too extravagant to assert that strict asepsis in primary amputations in railway surgery is impossible. The operation must be immediate; there is no time thoroughly to asepticize the skin of the region of operation and the adjacent parts of the body, much less to asepticize the intestinal canal, where germ life is so luxuriant, and, according to some, a source of distant local as well as of general infection.

Often, too, there are no facilities for sterilizing the water, the air is foul, and the assistants are the bearers of infectious germs. And yet, with all this, how often are we surprised at the results so favorable as regards subsequent suppuration.

In most of the subjects of amputation, youth and a general condition of robust health favor good results. These are the conditions of the great-

est resistance to germ development and infection. This may account in great part for the limited suppuration which occurs in most cases.

Certainly, not a little influence to prevent extensive suppuration must be ascribed to the drainage of the accumulations, which otherwise would be imprisoned in the flaps and furnish good soil for the development of infection, but the drainage tube, often a blessing, is always an irritant, and often a cause of inflammation. If the flaps can be closely approximated and retained in close apposition, open spaces will be avoided thereby, and there will be no need of drainage tubes.

The stump should be left as long as possible, for its usefulness as a support for an artificial appliance is directly as its length. This condition, however, very frequently is lost sight of in our efforts to secure uninjured flaps. The limit of injury to the skin in railway injuries requiring amputation in extremity cannot be determined. Just where bruised and lifeless skin ends it is rarely possible to decide. Skin that has been bruised or crushed, and yet not to the extent that makes it evident to sight or feeling, often sloughs and allows the stump flaps to separate and the bone to be exposed. This exposure of the bone is always serious, as it often leads to bone inflammation, which may be most extensive, protracted and severe. We cannot be indifferent to this possibility in our efforts to secure immediate healing.

Because of the greater advantages of a longer stump, it would seem that any means to secure it, even at a risk of a secondary operation, would be justifiable. A limited loss of skin would not be serious in itself, since by Thiersch's method of skin grafting, now so generally practiced, the loss resulting from sloughing of the flaps can quickly be made good.

The objections to the present procedure, in our efforts to secure prompter healing and a longer stump, have for a long time been met by us by following the plan of uniting the flaps throughout by means of cat-gut sutures. It goes without saying that the immediate union of the flaps by suture is a procedure applicable only in amputations in muscular parts of a limb, and, therefore, cannot be used where the skin is not associated with muscle in formation of the flap; hence, it is inapplicable in the circular method of amputation.

The flaps are made in the usual manner, always providing that muscle be included in each. After the complete arrest of the blood-flow, the flaps are approximated so that they fit, and the opposite points in each may be observed. Then, with a long, curved needle, armed with cat-gut of medium size, the deepest portions of the flap are brought together by means of long and deep sutures. In the placing of the first row of deep sutures, great care must be taken to cover closely the ends of the bone and avoid open spaces, which are more liable to be left at the end of the bone than anywhere else. Usually from three to five sutures are necessary for the deepest row. Then, in like manner, another row of like sutures should be taken across the stump, and then, finally, a third row, which will complete the union of the flaps throughout, except the skin; or, after the first row shall have been taken, as it often happens to be necessary, the remainder of the flaps may be united by sutures placed irregularly, to accommodate flaps which, for various reasons, may have been of irregular shape. The skin is now sutured in the usual manner, or by a running stitch.

In the use of these deep-buried sutures, it is obvious that certain rules must be scrupulously observed: First, the material for suture must be ab-

solutely aseptic. Second, all oozing from the flaps must have ceased, or assuredly be made to cease, by the suture. Third, the suture must be long and embrace a large amount of tissue. They should average one inch in length and reach a depth of half an inch into the muscle. The sutures should be separated from each other by from one-half to one inch. Fourth, the sutures must be drawn no tighter than may be necessary to bring the surfaces into contact and to hold them there, else the nutrition of the tissues included in the sutures would suffer. This rule is the same as that for the suturing of the skin in any operation; approximation and retention being gained without strangulation, the nutrition of the included tissue will be uninjured.

This plan of closing stumps in muscular parts of the limb offers many advantages. The bruising and crushing force which will destroy the surface skin is generally insufficient to cause the same destruction of the muscles beneath. It follows that should the skin subsequently slough, the muscles beneath will remain unaffected. If the muscles can be made to unite and form a firm, deeper covering to the end of the stump, considerable sloughing and loss of the skin may occur without detriment. The time of repair will be shortened, because of the readiness with which the skin can be resupplied by transplantation; and ample compensation will be found in the stump's increased length.

It may fairly be assumed that the strain to which the edges of the flap are subject in holding them together, in addition to their almost non-vitality as a result of the injury, often determines the death of the edge of the flap and inflammation. It can be seen very readily that if the flaps have been sutured firmly already before the skin edges have been drawn together, the skin will suffer no strain from the motion or position of the stump, and the circulation, which may have been but just sufficient for the skin's life, will not be arrested.

By this plan of suturing the flaps become immediately closed. There are no open spaces left, nor is it possible for spaces to be formed by the dressings which inadvertently may be too tight and so force the flaps apart within, or by the position of the stump on its supporting pillow.

The danger of infection is lessened by the early union of the flaps.

I do not know or contend that this method is new, or that the writer was the first to use it. Old or new, we hold from our experience in many cases of amputation with deep buried sutures uniting the deeper parts of the flaps, that it secures the following advantages: First, absence of spaces between the flaps. Second, prompt healing of the stump. Third, absence of drainage tubes. Fourth, longer stump.

DISCUSSION ON DR. VAN DUYN'S PAPER.

Dr. Warren, Sioux City, Ia.—I wish to take an exception to one statement made by the doctor in his paper just read. In his remarks concerning the importance of having railroad injuries aseptic, he asserts that the operation must be immediate. I think that every railway surgeon of any extended experience has learned the fact that the result of the immediate operation is frequently the death of his patient. My experience has taught me that the proper thing to do in cases, say, where we have an extensive injury of one or both extremities, is to immediately amputate but to ligate the larger vessels, apply an antiseptic dressing, after thoroughly cleansing the injured surface, and let your patient alone for twenty-four, forty-eight

or seventy-two hours, as the case may be. If you amputate in that way the results from amputations, in railway injuries, will be much more favorable. Any man who has had an extended experience in railway surgery knows that the results of immediate operations performed by assistants, or by attending physicians, without proper care for the reaction of the patient, have been the sacrifice of the injured person.

Dr. King—I think the doctor's paper, in the main, is a good one, and yet there are some points in the paper which, if I understood him correctly, I would like to controvert. The doctor speaks, in the first place, of the immediate operation—that is, that the operation is immediately necessary. Now, this I do not believe to be true. The fact is that an experience of eighteen or nineteen years in the care of railroad injuries has taught me that the immediate operation is not always the best. In some cases of slight injury, where there is very little shock, you are perhaps justified in going in and operating at once; but in the more serious cases demanding major surgical operations, such as, for instance, amputation of the thigh, where you have profound shock, I think, and I believe, every man who has had experience in these cases will hold with me, that the immediate operation is not the best thing to do. A man has been run over and his knee or leg, perhaps, has been crushed, demanding an operation above the knee; he is brought to the hospital with a pulse of perhaps 130 or 140; his countenance is pale and pinched; he has a dejected appearance; says he does not suffer or feel anything; he calls for nothing except, possibly, a drink of water; he is so shocked and his heart action so depressed that any injury inflicted upon him in addition to what he has already suffered will perhaps end his life in two or three hours. Our rule in such cases, during the past few years, has not been to operate immediately, but to render the wound as aseptic as possible; to open up the skin and bruised tissues and use our antiseptics through them; to control all hemorrhage; to put him to bed until reaction takes place and the man's general condition is such as to justify us in putting him upon the table for the purpose of making an examination of the parts and of taking such surgical measures as are necessary.

I will relate the case of a man brought to the Missouri Pacific hospital some two or three months ago. He was in a wreck in which ten cars were derailed, and he was pinned down by debris. It took two or three hours to get him out. He sustained a very serious scraping injury to the left leg, running down the thigh and leg, in which a very large amount of skin had been lost. He also suffered from a compound fracture of the tibia (right leg), bone projecting. We were satisfied from the nature of the shock that the anterior tibial artery was torn. We reduced the fracture, but finding it impossible to keep it in place, we put it up lightly and watched it. In twenty-four hours it was light pink in color and cold; in twenty-four hours more cold and dark. The man's pulse at that time was above 140; he was still in a state of shock, and in no condition to be operated upon. We were satisfied from our experience that if we put him upon the table and amputated the limb above the knee, we would kill him in half an hour. The question was then between allowing the man to be poisoned by a dead limb on the one hand, and, on the other hand, putting him on the table and killing him. We were between "Scylla and Charybdis," or, as the old man put it, "Si-silly on the one hand and 'Cherry-bobbis' on the other." My house surgeon, Dr. Geo. S. Hammill, solved the problem by splitting the dead leg into ribbons down to the bone, and, hanging an irrigator over it

and kept running over it almost constantly antiseptics of one kind and another, using the sublimate solution, kreoline and Thiersch's solution, which, you know, is six grains of boracic acid and one of salicylic acid to the ounce of water. These he kept running over this dead leg, preventing the absorption and entrance of gases from this dead tissue into the living tissue. We removed a good deal of the dead tissue, leaving the bone sticking out, and that bone remained in that condition for seven weeks before we concluded that we were justified in putting the patient on the table. We rendered the dead portion of the leg aseptic by constant irrigation with antiseptics. We finally removed all the soft tissues, and seven weeks afterwards put him on the table and amputated at the knee. I left the man in the Missouri Pacific hospital, hearty and well. Had that leg been left there without splitting it we would have lost it. Had we put him on the table immediately we would have lost him. So that we cannot make any fixed rule in these cases. He was twenty years old.

Dr. Griswold, Sharon, Pa.—Thiersch's solution is made of four parts of salicylic and one of boracic acid.

Dr. King—Thiersch's solution, doctor, is composed of six of salicylic and one of boracic acid. If I understand the doctor correctly, he said that in some instances it was not necessary to drain. I believe that drainage in railroad injuries is an absolute necessity; and the man who does not always provide for drainage is liable to get into trouble sooner or later. It is true, as we all know, that these men are brought to us having been ground into the dirt, and we find dirt and cinders and splinters of wood. I have found cow hair and all sorts of things ground into the tissues. It is almost impossible to get all of these foreign particles out, and if you amputate and close the stump with sutures, ligatures, etc., but do not provide for drainage, you will have sepsis, and this septic material not being able to escape is bound to enter the general system. Drainage at the lowest point is always the thing to be done. I think the doctor offers some very good suggestions with regard to suturing the internal parts of the limb. This is new to me. I think the matter of sewing the muscles over the stump first in layers one after the other, internally, and afterward the skin, is certainly calculated to do two things: secure union of the muscles under the skin and prevent retraction; and, in the next place, to prevent that union of the skin to the bone, which makes, as we often have, an immovable cicatrix over the end of the bone, which is always painful. I am going to adopt that idea hereafter. In some amputations of the extremities some of the muscles when cut retract more than others, and it has been suggested recently that the muscles be allowed to retract. If they have retracted unevenly you can then make the amputation and have smooth, even flaps, thus forcing the skin away from the bone and making an ideal stump. (Applause.)

Dr. Buchanan, Allegheny City, Pa.—I have been working for railroads for years and I never yet could solve the problem. I would say that in every case when you perform an operation every man must be the judge of each individual case. I have amputated at the thigh for railroad injuries run across up here (indicating); I have taken the limb off within three inches of the head of the bone and have had the patient removed to the West End hospital within one hour and in bed. I removed the limb with the patient on the ground. He was at that time forty-five years of age, and is still living. (Applause.)

If I had waited for reaction, as they call it, that man would have died. (Applause.) I have had other men who have come to me with minor injuries that I have had to lay by for a long time; so that there can be no set rule—every man must be the judge of his own individual cases. Dr. Murdoch saw this man whose limb I amputated at the hip.

Dr. King—You say if you hadn't amputated his leg immediately the man would have died. How do you know?

Dr. Buchanan—If I had waited for shock afterwards to come on he would have sunk; I don't think there is any question of it. I would like to know how Dr. King knows his man was going to live? (Laughter.)

Dr. A. S. von Mansfelde, Nebraska—Don't you think it true that an amputation made immediately after receipt of the injury is far less dangerous to the patient than if it had been made two or three hours after the injury?

Dr. Buchanan—If a man is in a state of profound shock, his pulse say 130. I would not do it. I would amputate immediately in all cases where the patient is able to talk and his pulse is good.

Dr. A. S. von Mansfelde—You mean right away, then? You don't mean two or three hours afterward?

Dr. Buchanan—I mean as soon as I saw him. He was carried in on a board, and I operated on him right away on that board.

Dr. King—You say if he had a good pulse, doctor?

Dr. Buchanan—Yes, sir.

Dr. Murdoch, Pittsburg, Pa.—It seems to me we have been treating the writer of this paper very unfairly in discussing another question entirely from what the paper contained. No part of the paper, so far as I heard, entered into the subject of primary or secondary amputation. It was only in regard to the use of the deep suture in bringing the deep parts of the wound together; and that is the only subject that is up for discussion. It is, therefore, very gratifying to know that Dr. King from Kansas City has been diverted from the real issue, and the question is as to the proper time for performing the amputation; whether it should be made immediately or at a remote period. This subject has been brought up by Dr. King of Kentucky City, and he has stated the case of a young man, twenty years of age, who was brought to the Missouri Pacific hotel at Kansas City, having been injured in a wreck, and in the course of seven weeks they were able to take off his limb. Dr. King stated (I don't know how he knows it) that unless this long period had been permitted to elapse before the operation the man would undoubtedly have died. How did he know it? (Great laughter.) My own experience has been like that of Dr. Buchanan. Every case is a case by itself. Every case of amputation that you have is a problem of its own, and you can lay down no dogmatic rules and say always do this or that. I will state as a general rule in a young man, twenty years old, who has received a traumatic injury, that, to allow that limb to go on until gangrene sets in and then make incisions largely involving the dead and the living tissues, in pursuing such a course you are much more liable to induce septic conditions than if amputation were performed immediately. By opening up the arteries and veins and making incisions between the dead and the living tissue, such a condition is very likely to bring on septicaemia; and for what purpose incisions should be made into the dead part is more than I can understand. (Applause.) If incisions are to be made in the living part, they should be made above the dead part and the limb should be amputated. Generally speaking, that

would be the rule which I consider should be pursued. In the Western Pennsylvania hospital at Pittsburg, it is the custom there to do immediate amputation. An old man was brought in there, as Dr. Buchanan states; the cars had traversed the limb, leaving just room to amputate below the hip joint, and Dr. Buchanan amputated, I think, within an hour.

Dr. Buchanan—Within ten minutes.

Dr. Murdoch—Well, that is near enough. The man made an uninterrupted recovery. We know he did live; we don't know that he died. (Applause.) Mr. Erichsen has asserted in his surgery that never again will he amputate from any patient but a youth, a limb which has been traversed by the cars, above the middle of the thigh. You will find that in the older editions of "Erichsen's Surgery." That he has done it so much, and the operation has been traversed by a car wheel above the middle of the thigh unless the patient is a youth. Erichsen's experience, I suppose, was derived from waiting to do the secondary operation; waiting to do just what Dr. King advises you to do, but loses his patients, generally. I have a history of five cases of immediate amputation at the thigh, and every one recovered. However, I am not discussing the paper read. I am discussing Dr. King's criticism, and I say again that I would not make a dogmatic rule, and I would advise you, gentlemen, not to accept a dogmatic rule in these cases; but that each individual case is a problem to be solved by itself. (Applause.)

Dr. Pearman—I do not wish to take up very much of your time, as this matter has been very thoroughly discussed. It is, however, one which I consider of paramount importance. I have practiced the principles advocated by those on each side of this question, and have suffered both by amputating too early and by deferring too long; at least, my patients have suffered (laughter), and I have a reputation, no doubt. It has been very aptly said here that each case is a case of its own. A surgeon must exercise good common sense in practicing surgery, as well as in anything else, and when a man is brought to you with a heart beat of 130 or 140, in which you cannot discover the second beat of the heart; is brought to you with one, perhaps both, limbs crushed; feels no pain; desires nothing but a drink of water, and knowing nothing about the extent of his injuries, and the pulse is not perceptible at the wrist. Amputate that limb and you kill your patient; whereas, if you would give proper treatment, stimulants, etc., and allow four, six, ten or twenty-four hours to elapse, as the case may be, in my judgment many times you save the life of your patient. More than that, it is plainly our duty to do what we conceive to be right; we must save; and we must defer, somewhat, to the wishes of the friends of the patient. I recollect one case where I amputated both limbs above the knee; they were mangled and crushed almost to atoms; he had a fair pulse and I waited until I thought the pulse was tolerably well established. The patient died and the friends said: "Doctor, why did you do it? You knew he would die?" I said, "I did not know he would die. I operated because I thought it would give him the best chance for his life." "Yes, Doctor, but he died." You see they blamed me for it. One case I wish to relate. It is a very singular one and always has bothered me. It occurred before I knew anything of antiseptics or antiseptic treatment. A young man was shot, the ball entering the axillary region. He was under the care of a friend of mine, who called to see me and asked me if I would not visit the patient with him. He said he wanted to go out and take the shot out of his arm, if the patient was living, which he did not expect he would

be. On examination we found the humerus entirely severed and no circulation in the arm at all; and we had gone unprepared to operate. We told the friends that we would have to come up next day and take the man's arm off at the shoulder. When we went up next day they met us at the door and said we were too late, that the young man was dying. He seemed to be dying. The arm was black and swollen—black from the shoulder down. The young man was delirious and it looked as though he would die in a very few minutes. We went home. In three or four days after that they sent us word to come up and take the young man's arm off; that he was still living. I received great censure in the neighborhood for not having taken it off. However, we went up. The patient had become rational within four or five days after the receipt of the injury. The line of demarcation had formed on the shoulder. I prepared to amputate, but he said it took three doctors to take a man's arm off at the shoulder, and he would not allow me to take it off. I made out as though I wanted to do it, but when the friends got him in the notion of having it done, I wasn't quite so anxious. (Laughter.) He said that I must wait until the next day and another doctor come there. I finally consented. The next day I was sick (laughter), and could not go; so I sent this other doctor up. The two went up and I stayed in town. I wasn't so sick but what I could stay in the office. (Laughter.) I wanted to hear the result on their return. When they got back I said, "How's the young man?" My friend says, "Oh, he's dead." (Laughter.) "Did you take his arm off?" "No," said he, "we put him under the anaesthetic, made a little incision here (indicating) and he died. We picked up our tools and came away." About three days after that one of the friends came to my office and said: "I wish you would come up and take that man's arm out of the bed." (Great Laughter.) I went up and did so. He is alive and working to-day, and can do as much with his one sound arm as an ordinary man can do with two. I think that was about eleven or twelve days from the time he sustained the injury; and my belief is that that man would have died if that limb had been removed at any time previous to that. (Laughter.)

Dr. W. B. Outten—I could not remain quiet after this child of mine (meaning Dr. King) had gotten used up so badly. And as for the way Dr. Murdoch used him up, I think he showed no mercy. In connection with this limb that got black and stayed black, mentioned by the doctor, a gentleman behind me says Dr. King's case is very slight compared with a case which occurred in his practice. He says: I have a case now where an arm has been black for the last eight months, but it's on a black man. (Laughter.) What I desire to say is simply this: When our Brother Murdoch presumes to say that each and every individual case has a separate history of its own, and then starts in and goes to work and gives Dr. King certain directions, and indicates thereby that there is absolute regularity concerning his particular case, but not in any others, he certainly does injustice to Dr. King. Now, then, in regard to certain points in connection with amputations, I wish to say that the sole indication by which we are guided as to when to amputate is the pulse. I don't believe that you can go beyond that point. We all know that we have conditions which may arise in certain cases from extreme shock, and where we have injuries so severe and so extreme as to indicate that it is almost impossible that the patient can be alive, and still have a condition of the pulse in which no shock has been made manifest. I could likewise cite to you serious cases in which we have to amputate, where, in consequence of injuries close to the

trunk, you find the patient with glassy eye, pale dull look on the face, and you think your patient will surely die—even in that condition you will frequently put your hand there (on the wrist) and find a pulse that is absolutely astonishing. In certain conditions after injuries the heart which has lost in force makes up for it in rapidity and it is simply beating itself to death. As regards the influence of shock, there is not a surgeon here who has not seen it. Where you have physical shock alone, your results are generally good; but where you have mental shock, in connection with physical shock, your results are invariably bad. Suppose a man catches his foot in a guard rail; he sees the engine coming upon him, and struggles to get free. Picture to yourselves all the horror that seizes upon the man. In addition to that, his limb has been crushed. There is mental, as well as severe physical shock, and you are incompetent to do anything. I believe that the best results are attained in the treatment of injuries where they have been inflicted in the night, and where there are no horrifying circumstances to create mental shock. Where the patient is not aware of the accident about to happen to him, and where there is physical shock only. (Applause.)

Dr. Maynard, Wyoming—I have tried both, and I have had them die when the secondary operation was performed and when I have operated early. Operate early, if possible, for I fully believe that the anaesthetic lessens shock, and helps to rally the patient. There is a point growing out of these discussions, "When to operate," which is of more practical benefit to us to-day than any other question that we may discuss. It is practical for the future, and anything and everything bearing upon this point will be, I think, of intense interest to us all. The consensus of opinion will largely help to guide one for his future action. I will go back for a moment and say that I believe the early operation, if you must make it, is the one to make, unless your patient is so near dead that you know he will succumb while you are performing it. I think this is a matter that should depend entirely upon the amount of injury sustained. I never hesitate to decide. I may be wrong. I think Dr. Outten is wrong sometimes; but I never hesitate to decide as to whether an operation must be performed or not. There is a question growing out of the discussions on railway crushes which, though not exactly germane to the paper read, has been a question with me for years. It was a question with Dr. John Hodgkin of St. Louis, a better man than whom never lived. God rest his soul. We have discussed it repeatedly, but never arrived at a satisfactory conclusion, and that is why in railway crushes, wheel grinds, I have to amputate farther away from the destroyed tissue than I would for a shell wound during the war? Why is this? Is it due to changed muscular structure, to the crushing of bone, or is it a dispensation of providence that we will never know anything about? A year from to-day I would like to hear this subject discussed.

Dr. Bouffleur—The remarks made so far seem to have been directed toward what is to become of the patient. There is no question in my mind but what we can save a good many limbs by waiting a few hours. I have in mind two or three cases which have occurred in the last year and a half which were about to be amputated by surgeons who have had years of railroad experience, and which by accident have fallen into my hands. In one of them, I found I could not get the consent of friends to amputate, and, therefore, placed the man upon what you might call an expectant plan

of treatment. The cars had passed directly over the foot and crushed two inches of it in length. We placed a compress wet boracic acid solution on that part of it, with the idea of preventing absorption from that decomposition which we supposed would be there. Was surprised to find, in next twenty-four hours, that there was circulation in that part of the foot. At first I could see no life in it, no circulation, absolute coldness. I made incisions into it with the knife with no response whatever from the patient; but after constantly irrigating it for twenty-four hours with the solution, there was circulation enough in that foot for me to amputate the dead tissue and to save that man's foot. I have had several cases of this kind. In the last week I succeeded in saving three-fifths of a man's thumb. It was entirely crushed off, with the exception of half an inch of skin. I placed it back on the hand and held it there by suitable bandage, after having dressed it. He will lose his nail, but is going to have the thumb left. The early amputation plan would have left that man without the thumb. I have demonstrated on several occasions that by using the boracic acid solution that parts can be rejuvenated and revived which are apparently dead. Therefore, I say that a little waiting is not always a bad thing. Just wait a little once in a while and take into consideration that it is possible by a little conservative and expectant treatment you can save perhaps only three inches extra length of stump. This three inches is so much more saved to the patient; and there is no question but what it can be done in many cases.

Dr. King—I wish to say that I did not advocate early amputation nor late amputation. I simply inveighed against the idea of amputating during shock. I simply say wait, when you feel from your past experience that the patient is not going to live. Of course, no one knows whether he is going to die or not; but if you think, as I say, from your past experience that he will not live during the operation don't amputate then, but wait until you think he is in condition to bear it.

The Sometime Necessity of Early Special Treatment in The Eye.

[By SURGEON JOSEPH A. WHITE, Richmond, Va.]

In offering a few remarks on this subject, I do not wish to be taken as pleading the cause of the specialist, and magnifying his importance; or of belittling the work of the local road surgeons. But it is a well known fact, that, unless a surgeon has had special training in eye surgery, or is in a community of sufficient size to call for frequent treatment of eye injuries, he, in the natural order of things, will grow rusty on this subject, and be hardly competent to handle such cases with the requisite skill and judgment. And this matter is of importance in more ways than one. The loss of an eye is not only a great affliction to the victim of the accident, but the loss of an eye that might have been saved by early appropriate treatment is a grave reflection on the surgical service of the road, and may involve the latter in legal complications from which there is no escape, except by paying heavy damages.

As you all well know, railroads are constantly fighting law suits that are always being instituted without any just ground, and without any real liability on the part of the road, and they are frequently compelled to pay damages most unjustly. How much more surely then are these corporations to lose suits where any neglect or mismanagement of a case of injury by the road surgeons can be demonstrated. Hence it is equally to the interest of the injured person, of the surgeon and of the railroad that such precautions should be taken as to insure the most approved treatment in eye injuries.

The injured person may be saved from the loss of an eye, and will be satisfied that all has been done that could have been done; the surgeon is exonerated from all blame, should the injury result disastrously; and the railroad stands on the best defensive ground in case suit should still be instituted, in spite of the liberality and kindness of the corporation. That the roads recognize the importance of the medico-legal aspect of this question is shown by the fact that many of them have added ophthalmic surgeons to their corps of medical officers, and that others are daily falling into line in this respect.

To exemplify these remarks, allow me to report the following cases:

Case 1—F. A. D—, twenty-two years of age, blacksmith, employed in the C. & O. shops at Richmond, Va., was occupied Oct. 15, 1892, in "centering a spring," when a chip flew from the spring and wounded the left eye. He was at once sent to the local surgeon who turned him over to me with the request that I examine and report on the case.

I found a penetrating wound of the cornea about a quarter of an inch long, half-way between its central meridian and lower margin; the anterior chamber was filled with blood, probably due to injury of the iris. This was all that could be determined by simple inspection. He was positive that there was nothing in the eye, being satisfied that whatever wounded him had not gone inside. However, I evacuated the blood from the chamber by depressing the lips of the wound with a flat spatula to investigate this question for myself. After the blood was removed, I examined the eye with a strong illumination, found the iris wounded in its inferior nasal quadrant, and thought I could detect the sheen of steel at the lower margin of the lens. Using a small sterilized probe, I could feel the piece of metal. I decided to remove it with the electric magnet, thinking it would be an easy matter, as it seems quite small. After sterilizing the eye and magnet point, I introduced the latter through the wound, and each time I turned on the current I could hear the click of the metal against the magnet; but pull as I would, I could not dislodge it. Any traction on the magnet gave the patient the sensation of having the eye pulled inside out, and I saw clearly that I continued the attempt I would turn the lens upside down before the piece of steel would come away.

It had gone from without, inwards and downwards, passing through the cornea, iris and the lower margin of the lens behind and below which it was resting on the ciliary bodies. I enlarged the corneal wound from margin to margin as if to extract the lens, and then reapplied the magnet. Direct traction again threatened to dislocate the lens, and I then pushed the foreign body down and in, to disengage it from the lens, and turning it quickly to the front, I succeeded in dislodging and removing it from the eye. In doing so, I pulled the lens up and out, without, however, dislocating it into the vitreous. A little vitreous followed the foreign body out of the eye,

which was dressed antiseptically and the patient sent home. Atropia, sulph. solution and ice compresses were ordered, and the next day when I saw him there had been very little reaction and the eye was doing well. In four or five days the wound was apparently healed, no blood in the anterior chamber, the pupil was oval shaped, the iris being drawn somewhat down and in, and the lens seemed to be in its normal position, although cloudy at its lower margin. The case made a rapid recovery, but the lens gradually became cloudy throughout. I have needled the cataract twice, whilst there is still some cloudy capsule occupying the inner part of the pupil his vision is $\frac{20}{70}$ with $+9D = \times 2D^c \times 90^\circ$. This will be further improved by getting rid of the cloudy capsule. The present appearance of the eye is shown by Fig. 1.



CASE 1.—Eye from which steel was removed, with cloudy capsule and opanties of corner. As it looks at present.

Had the presence of the foreign body not been determined, and had it not been removed by the magnet (and there was no other way to do it without destroying the eye), he would undoubtedly have lost his eye. Would its presence have been demonstrated, and would it have been removed soon enough by the average road surgeon? It is hardly necessary to answer this question, and even if this had not been done, there would have been no reflection on the surgeon, because the injury was of a character outside his usual experience, and he could not have been expected to do what had to be done in the case to save the eye. Even if he had detected the foreign body, he could not have removed it, unless he lived in a place of some size, because he would not have had and could not immediately have gotten suitable apparatus. In all probability the case would have received every care and attention, the eye would have been dressed antiseptically *secundum artem*, the wound would have healed kindly and the eye have resumed an almost normal appearance, but imprisoning a foreign body that would have eventually destroyed it by slow cyclitis and possibly its fellow my sympathetic ophthalmia.

That such a course of procedure would have been apparently justifiable, I admit, because with the exception of the blood in the anterior chamber there was no sign of a foreign body in the eye, and the man was positive that he was wounded by a fragment which fell to the ground.

Another case not so serious in its nature, but involving the risk of loss of the eye if it had not received immediate proper treatment is the following, and you will observe the similarity of the two cases on first appearance:

Case 2. S. S. G—, forty years of age, a car repairer at the C. & O. shops in Richmond, was wounded in the right eye by a piece of steel on Jan. 19, 1893. He was sent to the local surgeon at once who transferred him to my care. I found a penetrating wound of the sclerotic about three-eighths of an inch long in the inferior external quadrant, just behind the insertion

of the iris, through which vitreous was protruding. The anterior chamber was filled with blood, and no view of the interior could be obtained. I cut off the projecting vitreous and passed a sterilized flat spatula between the lens and iris into the pupillary area and by slightly tilting it, evacuated most of the blood. The lens was partially displaced. I could find no evidence of the presence of a foreign body. I applied ice compresses, ordered atropia solution to be instilled and dressed the eye antiseptically. The wound healed rapidly and in ten days the eye looked as natural as ever, except that the pupil was drawn somewhat down and out. Sight, however, was seriously impaired, although the refractive media were perfectly clear, except a few opaque spots in the lower and outer periphery of the lens. V. was $\frac{12}{100}$ only. This was due to the resulting antigmatism and with $-0.50D = +3^5D^C$ ax. 60° ; his vision May first was $\frac{20}{40}$, an excellent result.

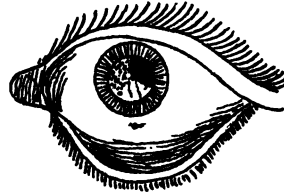


CASE 2.—Showing location of wound and condition of pupil after eye healed.

This case would, in all probability, have resulted equally well in the hands of any careful physician, but I cite it to show that it is difficult to know on first examination whether such injuries require special treatment or not. In both of these cases there was a serious wound of the eye, and in both the eye was apparently filled with blood. Both had been wounded by a piece of steel, both were equally confident that no foreign body had entered the eye. At first glance, with the exception that one wound was in the cornea, and the other in the sclera, the two cases were exactly alike. In fact the second case would have appeared to be more serious in its nature than the first, because the wound was in the ciliary region, and according to all teaching on the subject exposed the patient to the risk of sympathetic disease. Yet the first would have been certain to lose his eye, and the second to save his under the same treatment. Could I better exemplify the sometime necessity of expert opinion and treatment in these injuries of the eye?

Case 3. O. A. W—, engineer, thirty-five years old, C. & O. R.R., was sent to me March 13, 1893. Three weeks previously his left eye and eyelid had been injured by the breaking of a cab window in a storm. The lower lid had received a penetrating wound from the broken glass and the sclera was slightly cut about three-eighths of an inch below the lower corneal margin. At the time of his visit to me, the lid and sclera had healed, and the eye was apparently normal looking. Examination with the ophthalmoscope showed it, however, to be filled with blood. I could get no history of a foreign body, as both he and his physician were sure there was no injury of the globe beyond the slight wound of the sclerotic and the effects of the concussion. I felt satisfied there was a piece of glass in the eye, but in the face of his vigorous protest to the contrary, I simply told him of the possibility of the removal of the eye, provided treatment

did no good Under hypodermic use of pilocarpine, the blood slowly absorbed, but at the same time the tension became steadily less and symptoms of phthisis bulbi showed themselves. Up to this time he keeps the eye in the vain hope of saving it. It is now very soft, somewhat congested, the pupil well dilated, but oval, and the blood inside almost entirely absorbed. With the ophthalmoscope a slight reddish reflex can be



CASE 3.—Showing condition of eye when last seen. The black part of pupil is normal, the gray represents detached retina and the white a deposit of lymph around the foreign body. The black spot below the iris shows location of wound.

gotten in the upper and outer quadrant no reflex up and in; a gray reflex directly in, as if the retina was detached in that locality and downwards can be seen a whitish elevation with blood vessels running over it, resembling more than anything else an accumulation of lymph over and around the injured part of the sclerotic. I am satisfied this encloses a piece of glass, but this surmise can be demonstrated only by removing the eye. I have urged its removal, but without obtaining his consent.*

Case 4. G. B.—, negro, aged thirty, laborer on C. & O. R. R., was injured February 14th in the right eye whilst crushing stone with a sledge. He came to me on March 18th, nearly five weeks after the injury. At that time there was a wound of the cornea through which the iris had prolapsed and grown to its edges and the lens was cataractous. The tension was abnormally high, the eye exquisitely tender to the touch and so painful that anodynes had very little effect. The first night in the hospital the resident physician was obliged to give a hypodermic injection of a quarter of a grain of morphia after he had taken two doses by the mouth, before he was relieved. I could get no satisfactory history of the case, and with the information obtainable and the appearance of the eye, I diagnosed "secondary glaucoma and cyclitis due to a wound of the cornea and lens with hernia of the iris." I advised the removal of the eye, to which he consented. He was at once relieved by the operation and in a week left for his home.

Both these latter cases lost the eye, but in neither could the loss be attributed to any neglect on the part of the road or the local surgeons. Case 3 would have lost his eye under any treatment, and under the care of the most expert ophthalmic surgeon, and unless he takes good advice to have the eye removed, he may lose the other eye as well. Notwithstanding this fact, the injury was of sufficient serious nature to have had an expert opinion as soon as possible. Case 4 had the eye removed, but only because his sufferings had been intolerable. Would he have fared any better if he

* On July 4th, 1893, this case returned to me and consented to the removal of the eye. I found a long slender piece of glass one-half inch long and one-sixteenth inch in diameter, imbedded in the lymph mass, above described, in the region of the wound as it appeared with the ophthalmoscope—thus verifying my diagnosis.

had gone at once to an ophthalmic surgeon? Possibly yes! Probably no! He was advised to do so, and did not, so that if he had a chance he threw it away, and if he is like the average man, he in all probability blames the road for the result of his own neglect.**

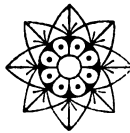
DISCUSSION ON DR. WHITE'S PAPER.

Dr. Curry—I consider, gentlemen, that this paper is of too great importance and interest to all parties concerned to allow it to pass without some discussion. I did not intend to say one single word, not being prepared to do so; but, observing the silence of the members present thought that the golden opportunity was passing. The cases recited in this paper could be handled, as the essayist so graphically stated, perhaps, only by a man who was peculiarly prepared and with the instruments all ready for such work. But there are classes of cases, gentlemen, not containing minute foreign bodies and not requiring an almost superhuman skill to detect and which are, perhaps, grave in their results to the patient, as these that have been related—grave only because correct treatment has not been applied at the proper time. Correct treatment gives a brilliant and satisfactory result and good vision to the patient. Incorrect treatment, or loss of time, means blindness and a condition which it is impossible afterwards to overcome. These cases, unlike many others, will not wait, and when the opportunity for correct treatment has passed all the skill in the world cannot bring back the conditions which will relieve the diseased part. There is the trouble. An injury even slight is produced where the cornea is knocked all to pieces. Where the lesion is great, anybody can see it; but here is an eye that has been injured perhaps not to such an extent. There may be beginning the slightest kind of an inflammation of the cornea or a keratitis. It is overlooked. There may be a very minute foreign body buried in the cornea and casual examination will never see such a foreign body as that. It requires skill and knowledge of the various kinds of light that strike the eye to find many of these minute particles; and to remove them before any inflammation or inflammatory action commences is an absolute necessity. This done and the eye is in fairly good condition. If that particle be not removed and it is allowed to remain in it, it irritates and aggravates it, plastic adhesions form, and inside of a week no power on earth can place that eye back to its normal condition. All these things could have been obviated by the correct treatment and at the proper time. I am very glad that Dr. White has presented this subject, not in the interest of specialists as he says, but as an absolute fact; as things which we all ought to know; as things which railroad companies ought to know. There are some other things which, in my opinion, railroad companies should know. I believe to-day the lives of passengers are jeopardized by the imperfect

** July 11th this case returned for treatment, because his sight was failing rapidly in his left eye. I found his vision about $\frac{2}{200}$ and the cause of this depreciation was a neuro-retinitis probably of sympathetic origin. In all probability the sympathetic neuritis had already developed as a post-ocular inflammation prior to the removal of the right eye and extended to the papilla and retina after his return home, because there were no ophthalmoscopic signs of it when he left the Eye Infirmary. Under Iodide of potash and mercurialization he rapidly recovered. In two weeks he went home with his sight restored. As I surmised, he came back thoroughly drilled by some one to make a claim against the road for damages, although the road was in no way responsible.

vision of engineers and firemen. Of course, it bears upon the engineer principally. In some cases which have come under my personal observation they could have been relieved by simply correcting the refractive error. I find many engineers, looked upon as the most competent upon the roads, whom I venture to say, on an absolute test, would admit that they could hardly tell a man from a cow two hundred feet distant. Investigation shows that there is an error of refraction and by correction with glasses that man's vision is made as good as any one's. The reason they are going on in this way is that they are afraid that if they put on glasses that the management will say at once, "that man has diseased eyes and is not fit for his position.." As it is getting late now, gentlemen, I will not take up any more of your time. (Applause.)

Mr. B. F. Wilson—Not being a specialist, I merely wish to say how important it is that we surgeons should be able to decide whether it is necessary to send those cases to specialists, so that the companies may not be mulct in damages owing to our incompetency, and want of knowledge in this special line.



CHAPTER IV.

The Organic Law of the Association and a Record of Its Members.

The following honorary members were elected at the Buffalo meeting, 1891:

Nicholas Senn, M. D., Ph. D., L. L. D., Professor of Surgery in Rush Medical College, Chicago, Ill.
 W. W. Dawson, M. D. LL. D., Professor of Surgery Medical College of Ohio, Cincinnati, Ohio.
 Mr. Charles M. Hayes, General Manager Wabash System, St. Louis Mo.
 Mr. W. E. Jones, General Claim Agent M. P. Ry., St. Louis, Mo.
 Hon. Alex. Cochrane, General Solicitor M. P. Ry., St. Louis, Mo.
 Hon. Frank Jones, President B. & M. Ry., Portsmouth, N. H.
 Mr. James E. Childs, General Manager N. Y. O. & W. Ry., New York, N. Y.
 Hon. Frederick Smyth, President C. & M. Ry., Manchester, N. H.
 Mr. G. W. Stevens, Gen. Mngr. C. & O. Ry., Richmond, Va.
 Mr. S. H. H. Clark, Gen. Mgr. M. P. & U. P. Rys., St. Louis, Mo.
 Mr. Frank B. Clark, Traffic Mgr. St. P. M. & O. Ry., Omaha, Neb.
 Mr. S. E. Williamson, Gen. Counsel N. Y. O. & St. L. Ry., Cleveland, Ohio.
 Mr. G. W. Bartlett, Gen. Supt. B. R. & P. Ry., Rochester, N. Y.
 Mr. Lewis Williams, Gen. Supt. N. Y. C. & St. L. Ry., Cleveland, Ohio.
 Mr. W. C. Brown, Gen. Mgr. H. & St. J. Ry., St. Joseph, Mo.
 Mr. S. E. Crane, Gen. Supt. H. & St. J. Ry., Brookfield, Mo.
 Mr. J. B. Yohe, Master Trans. P. L. & E. Ry., Pittsburg, Pa.
 Mr. C. D. Law, Supt. W. Div. P. F. W. & C. Ry., Ft. Wayne, Ind.
 Mr. A. B. Starr, Supt. E. Div. P. F. W. & C. Ry., Allegheny, Pa.
 Mr. Joseph Wood, Gen. Mgr. Penna lines west of Pittsburg, Pittsburg, Pa.
 Mr. Geo. W. Holdridge, Gen. Mgr. B. & M. Ry., Omaha, Neb.
 Col. Orland Smith, 1st Vice Pres. B. & O. Ry., Baltimore, Md.
 Capt. W. W. Peabody, 1st Vice Pres. B. O. S. Ry., Cincinnati, Ohio.
 Dr. John McIntyre, St. Louis, Mo.

Mr. Charles Truax, Chicago, Ill.
 Thomas H. Manley, M. D., New York, N. Y.
 Mr. A. L. Mohler, Gen. Mgr. G. N. Ry., St. Paul, Minn.
 Mr. R. Bell, Gen. Mngr. W. N. Y. & P. Ry., Buffalo, N. Y.
 Mr. F. M. Gault, Gen. Mgr. C. & St. L. Ry., Council Bluffs, Ia.
 Mr. C. H. Ackert, Gen. Mgr. Iowa Central, Marshalltown, Ia.
 Mr. Edmond L. Tyler, Gen. Mgr. A. & W. P. Ry., Atlanta, Ga.
 Mr. R. C. Richards, Gen. Claim Agt. C. & N. W. Ry., Chicago, Ill.
 Roswell Park, A. M. M. D., Buffalo, N. Y.
 Herman Mynter, M. D., Buffalo, N. Y.
 Mr. J. M. Edwards, Vice Pres. and Gen. Mgr. L. N. O. & T. Ry., Memphis, Tenn.
 Mr. O. H. Pond, Supt. C. S. & H. Ry., Columbus, Ohio.
 Mr. T. M. Pellar, Gen. Supt. T. & O. C. Ry., Toledo, Ohio.
 Mr. Roswell Miller, Pres. C. M. & St. P. Chicago, Ill.

The following roll of honorary members were elected at the Old Point Comfort meeting, 1892:

Mr. M. E. Ingalls, Pres. C. C. C. & St. L. Ry., Cincinnati, Ohio.
 Mr. Joseph Ramsey, Jr., Gen. Mgr. C. C. C. & St. L. Ry., Cincinnati, Ohio.
 Mr. A. A. Robinson, 2d Vice Pres. and Gen. Mgr. A. T. & S. F. Ry., Topeka, Kan.
 Mr. David McCargo, Gen. Supt. A. V. Ry., Pittsburg, Pa.
 Mr. J. T. Odell, Gen. Mgr. B. & O. Ry., Baltimore, Md.
 Mr. Wm. H. Barnes, Gen. Mgr. B. & A. Ry., Boston, Mass.
 Mr. C. C. Waite, Pres. C. H. V. & T. Ry., Columbus, Ohio.
 Mr. M. D. Woodford, Pres. and Gen. Mgr. C. H. & D. Ry., Cincinnati, Ohio.
 Mr. John M. Whitman, Gen. Mgr. C. & N. W. Ry., Chicago, Ill.
 Mr. E. St. John, Gen. Mgr. C. R. I. & P. Ry., Chicago, Ill.
 Mr. John M. Egan, Pres. and Gen. Mgr. C. St. P. & K. C. Ry., St. Paul, Minn.
 Mr. James Charlton, Gen. Pass. and Ticket Agt. C. & A. Ry., Chicago, Ill.
 Mr. W. F. Merrill, Gen. Mgr. C. B. & Q. Ry., Chicago, Ill.
 Mr. E. W. Winters, Gen. Mgr. C. St. P. M. & O. Ry., St. Paul, Minn.
 Mr. T. A. Mackinnon, Gen. Mgr. C. & M. Ry., Concord, N. H.
 Mr. A. J. Earling, Gen. Mngr. C. M. & St. P. Ry., Chicago, Ill.
 Mr. T. G. Shaughnessy, Vice Pres. C. P. Ry., Montreal, Can.
 Mr. N. Monsarrat, Pres. and Gen. Mgr. C. A. & C. R. R., Columbus, Ohio.
 Mr. Chas. L. Stone, Gen. Pass. and Ticket Agt. C. & E. I. R. R., Chicago, Ill.
 Mr. W. F. Fitch, Gen. Man. D. S. S. & A. R. R., Marquette, Mich.
 Mr. W. S. Alexander, Pres. and Gen. Man. E. R. of Minn., St. Paul, Minn.
 Mr. W. C. Hughart, Pres. G. R. & I. R. R., Grand Rapids, Mich.
 Mr. J. T. Harahan, 2d Vice Pres. Ill. Central R. R., Chicago, Ill.
 Mr. R. W. Woodford, Gen. Man. W. & L. E. R. R., Toledo, Ohio.
 Mr. R. B. Cable, Gen. Man. J. T. & K. W. R. R., Jacksonville, Fla.
 Mr. Geo. H. Nettleton, Pres. and Gen. Man. K. C. Ft. S. & M. R. R., Kansas City.
 Mr. Geo. L. Bradbury, Gen. Mngr. L. E. & W. R. R., Indianapolis, Ind.
 Mr. J. G. Metcalfe, Gen. Man. L. & N. R. R., Louisville, Ky.
 Mr. Rollin H. Wilbur, Asst. Gen. Man. L. V. R. R., South Bethlehem, Pa.
 Mr. W. H. McDoel, Gen. Man. L. N. A. & C. R. R., Chicago, Ill.
 Mr. Geo. C. Smith, Asst. Gen. Man. M. P. R. R., St. Louis, Mo.
 Mr. H. B. Ledyard, Pres. and Gen. Man. M. C. R. R., Detroit, Mich.
 Mr. James C. Clark, Pres. and Gen. Man. M. & O. R. R., Mobile, Ala.
 Mr. W. S. Mellen, Gen. Man. N. P. R. R., St. Paul, Minn.
 Mr. J. W. Thomas, Pres. and Gen. Man. N. C. & St. L. R. R., Nashville, Tenn.
 Mr. Theodore Voorhees, Gen. Supt. N. Y. C. & H. R. R., New York, N. Y.
 Mr. Joseph H. Sabds, Vice Pres. and Gen. Man. Norfolk & W. R. R., Roanoke, Va.
 Mr. D. W. Caldwell, Pres. N. Y. C. & St. L. R. R., Cleveland, Ohio.
 Mr. John F. Barnard, Pres. and Gen. Man. O. & M. R. R., Cincinnati, Ohio.
 Mr. H. S. Haines, Vice Pres. Plant System, New York, N. Y.
 Mr. Chas. E. Pugh, Gen. Man. Penna. R. R., Philadelphia, Pa.
 Mr. A. E. Welby, Gen. Supt. R. G. W. R. R., Salt City, Utah.
 Mr. W. H. Green, Gen. Man. R. & D. R. R., Atlanta, Ga.
 Mr. S. R. Ainslie, Gen. Man. W. C. R. R., Chicago, Ill.

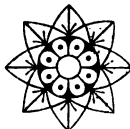
- Mr. E. C. Smith, Pres. C. V. R. R., St. Albans, Vt.
 Mr. D. E. Maxwell, Gen. Man. Purchasing Agt. F. C. & P. R. R., Jacksonville, Fla.
 Mr. H. G. Burt, Gen. Man. F. E. & M. V. R. R., Omaha, Neb.
 Mr. F. D. Underwood, Gen. Man. M. St. P. S. S. M. R. R., Minneapolis, Minn.
 Mr. Payson Tucker, Gen. Man. and Vice Pres. Maine Cent. R. R., Portland, Me.
 Mr. A. A. McLeod, Pres. and Gen. Man. P. & R. R. R., Philadelphia, Pa.
 Mr. S. M. Williams, 2d Vice Pres. C. R. R. of N. J., New York, N. Y.
 Mr. R. Carroll, Gen. Man. Q. & C. R. R., Knoxville, Tenn.
 Mr. W. J. Spicer, Gen. Man. C. & G. T. R. R., Detroit, Mich.
 Mr. C. J. Ives, Pres. and Gen. Supt. B. C. R. & N. R. R., Cedar Rapids, Ia.
 Mr. L. M. Johnson, Gen. Man. M. I. R. R., Ciudad Porfirio Diaz, Mex.
 Mr. Theodore D. Kline, Gen. Man. C. de F. N. M. R. R., Mexico City, Mex.
 Judge J. K. Cowen, Gen. Counsel B. & O. R. R., Baltimore, Md.
 Judge J. H. Collins, Chief Counsel B. & O. R. R., west of Ohio river, Columbus, O.
 Mr. Harry P. Robinson, Pres. Railway Age & Northwestern Railroader, Chicago, Ill.
 Mr. Horace R. Hobart, Vice Pres. Railway Age & Northwestern Railroader, Chicago, Ill.
 Mr. Hugh M. Wilson, Sec. Railway Age & Northwestern Railroader, Chicago, Ill.
 Mr. E. H. Talbott, 15 Wall St., New York, N. Y.
 Mr. J. J. Hill, Pres. G. N. R. R., St. Paul, Minn.
 Mr. W. A. Scott, Gen. Supt. C. St. P. M. & O., St. Paul, Minn.
 Mr. Fred. C. Hubbell, Gen. Supt. D. M. N. & W., Des Moines, Ia.
 Mr. T. M. Bates, Supt. Transportation C. & A., Bloomington, Ill.
 Mr. C. H. Chappell, Gen. Man. C. & A. R. R., Chicago, Ill.
 Mr. W. K. Morley, Div. Supt. C. & A. R. R., Roodhouse, Ill.
 Mr. E. J. Sanford, Asst. Supt. C. & A. R. R., Slater, Mo.
 Mr. B. R. Swoope, Gen. Supt. S. F. R. R., Sanford, Fla.
 Mr. Chas. H. Rockwell, Gen. Supt. C. & E. I. R. R., Chicago, Ill.
 Mr. H. W. Knauff, Sec. N. P. B. A. R. R., St. Paul, Minn.
 Mr. F. B. Drake, Gen. Man. C. J. & M. R. R., Toledo, Ohio.
 Mr. S. R. Callaway, Pres. T. St. L. & K. C. R. R., Toledo, Ohio.
 Mr. Robt. Nellson, Gen. Supt. P. & E., also N. C. R. R., Williamsport, Pa.
 Mr. Geo. B. Roberts, Pres. Penna. R. R., Philadelphia, Pa.
 Mr. J. R. Kenly, Gen. Man. Atlantic Coast Line, Wilmington, N. C.
 Mr. J. D. Laying, Gen. Supt. W. S., New York, N. Y.
 Mr. C. W. Bradley, Gen. Supt. W. S., Weehawken, N. J.
 Mr. T. J. McGuire, Asst. Supt. L. N. A. C. R. R., Monon, Ind.
 Mr. Geo. K. Lowell, Asst. Supt. L. N. A. & C. R. R., Lafayette, Ind.
 Mr. James Barker, Gen. Pass. Agt. L. N. A. & C. R. R., Chicago, Ill.
 Mr. Wm. McLeod, Vice Pres. and Gen. Man. Orange Belt, Oakland, Fla.
 Mr. J. C. Hinsey, Special Agt. C. M. & St. P., Chicago, Ill.
 Mr. J. C. Anderson, Gen. Pass. Agt. N. Y. O. & W. R. R., New York, N. Y.
 Mr. H. I. Miller, Supt. P. C. C. & St. L. R. R., Louisville, Ky. ●
 Mr. Geo. L. Bradbury, Gen. Man. L. E. & W. R. R., Indianapolis, Ind.
 Mr. D. S. Hill, Gen. Supt. L. E. & W. R. R., Indianapolis, Ind.
 Mr. J. H. McConnell, Gen. Supt. Machy & Motive Power, U. P., Omaha, Neb.
 Mr. E. D. Dickinson, Asst. Gen. Man. U. P., Omaha, Neb.
 Mr. W. M. Newbold, Supt. L. & N. R. R., Birmingham, Ala.
 Mr. W. E. Gray, Gen. Man. K. C. O. & S. R. R., Kansas City, Mo.
 Mr. Frank M. Hill, Gen. Supt. K. C. N. & Ft. S., Kansas City, Mo.
 Mr. J. H. Pickering, Supt. K. C. S. B., Kansas City, Mo.
 Judge J. M. Thurston, Gen. Atty. U. P. R. R., Omaha, Neb.
 Mr. W. B. Ryder, Supt. Georgia Pac., Birmingham, Ala.
 Mr. J. S. B. Thompson, Asst. to Gen. Man. R. & D. R. R., Atlanta, Ga.
 Mr. Edward Berkley, Supt. R. & D., Richmond, Va.
 Mr. T. O. Troy, Acting Supt. R. & D., Alexandria, Va.
 Mr. J. A. Dodson, Supt. C. & A., Columbia, S. C.
 Mr. C. P. Hammond, Supt. R. & D. Atlanta, Ga.
 Mr. A. B. Andrews, 2d Vice Pres. R. & D. R. R., Raleigh, N. C.
 Mr. James L. Taylor, Gen. Pass. Agt. R. & D. R. R., Atlanta, Ga.
 Mr. John C. Winder, Gen. Man. Sea Board Air Line, Raleigh, N. C.
 Mr. L. S. Thorne, Supt. of Transportation T. & P. R. R., Dallas, Tex.

Mr. Gaston Meslier, Gen. Pass. and Ticket Agt. T. & P. R. R., Dallas, Tex.
 Mr. G. A. Quinlan, Gen. Supt. H. & T. C. R. R., Houston, Tex.
 Mr. A. Faulkner, Gen. Pass. and Ticket Agt. H. & T. C., Houston, Tex.
 Mr. H. F. Whitcomb, Gen. Man. M. L. S. & W. R. R., Milwaukee, Wis.
 Mr. Geo. F. Bidwell, Gen. Supt. M. L. S. & W. R. R., Milwaukee, Wis.
 Mr. A. F. Banks, Traffic Mgr. I. C. R. R., Marshalltown, Ia.
 Mr. C. W. Lanpher, Gen. Trans. N. Y. O. & W. R. R., Norwich, N. Y.
 Mr. Frank L. Sheppard, Gen. Supt. Penn. R. R., Altoona, Pa.
 Mr. John W. Sanborn, Gen. Man. B. & M. R. R., Boston, Mass.
 Mr. Lucius Tuttle, Gen. Man. N. Y. N. H. & H. R. R., New Haven, Conn.
 Mr. J. J. Turner, Supt. P. C. C. & L. R. R., Pittsburg, Pa.
 Mr. C. D. Gorham, Supt. N. Y. C. & St. L. R. R., Ft. Wayne, Ind.
 Mr. C. M. Ward, Gen. Man. S. C. R. R., Charleston, S. C.
 Mr. J. W. Maxwell, Supt. M. K. & T. R. R., Denison, Tex.
 Mr. Jas. McCrea, 1st Vice Pres. Penna. R. R., Pittsburg, Pa.
 Mr. L. A. Daffan, Supt. H. & T. C. R. R., Corsicana, Tex.
 Hunter McGuire, M. D., Richmond, Va.
 Robt. E. Weir, M. D., Richmond, Va.
 Fred. S. Dennis, M. D., New York City.
 Stephen Smith, M. D., New York City.
 Lewis A. Stinson, M. D., New York City.
 Jos. D. Bryant, M. D., New York City.
 L. S. Pilcher, M. D., Brooklyn, N. Y.
 John D. Rushmore, M. D., Brooklyn, N. Y.
 Jonathan Wright, M. D., Brooklyn, N. Y.
 Geo. R. Fowler, M. D., Brooklyn, N. Y.

The following honorary members were elected at the Omaha meeting, 1893:

Mr. L. J. Seargeant, Gen. Mgr. Grand Trunk Ry., Montreal, Can.
 Mr. P. P. Shelby, Gen. Mgr. Coast Line G. N. Ry., Seattle, Wash.
 Mr. B. A. Kimball, Managing Director C. & M. Ry., Concord, N. H.
 Mr. Jno. H. Pearsons, Managing Director C. & M. Ry., Concord, N. H.
 Mr. Chas. A. Busit, Managing Director C. & H. Ry., Laconia, N. H.
 Mr. Geo. Van Keuren, Supt. Jefferson Div. Erie Ry., Carbondale, Pa.
 Mr. Robt. Pitcairn, Gen. Agt. and Supt. Penna. Div. Penna. Ry., Pittsburgh, Pa.
 Mr. Samuel Sloan, Pres. D. L. & W. Ry., New York, N. Y.
 Mr. W. F. Halstead, Gen. Mgr. D. L. & W. Ry., Scranton, Pa.
 Mr. E. McNeill, Asst. to Pres. Iowa Central Belt Ry., Marshalltown, Ia.
 Mr. T. C. Purdy, Vice Pres. M. K. & T. Ry., Parsons, Kan.
 Mr. W. P. Robinson, Jr., Gen. Mgr. St. J. & G. I. Ry., St. Joseph, Mo.
 Mr. Jno. B. Smith, Pres. Erie & Wyoming Ry., Dunmore, Pa.
 Mr. Geo. B. Smith, Supt. Erie & Wyoming Ry., Dunmore, Pa.
 Mr. W. H. Burns, Pres. and Gen. Mgr. Mont. Union Ry., Butte, Mont.
 Mr. A. C. Salesburg, D. L. & W. Ry., Utica, N. Y.
 Mr. J. G. Willis, Gen. Mgr. Vandalla Ry., Terre Haute, Ind.
 Mr. E. L. Poole, Claim Agt. C. St. P. M. & O. Ry., St. Paul, Minn.
 Mr. W. D. Tyler, Pres. and Gen. Mgr. W. & C. R. Ry., Walla Walla, Wash.
 Mr. J. H. Lothrop, Mgr. Kearney & B. H. Ry., Kearney, Neb.
 Mr. J. Q. Van Winkle, Gen. Mgr. C. C. C. & St. L. Ry., Indianapolis, Ind.
 Mr. A. T. Wikoff, Pres. and Gen. Mgr. C. & M. Ry., Cambridge, Ohio.
 Mr. J. D. Besler, Gen. Supt. C. B. & Q. Ry., Chicago, Ill.
 Mr. E. C. Murphy, Gen. Mgr. H. & S. Ry., Clarinda, Ia.
 Mr. J. W. Wardell, Gen. Mgr. C. C. & S. Ry., Cleveland, Ohio.
 Mr. J. T. Gerry, Supt. B. & G. W. Ry., Burlington, Ia.
 Mr. Chas. M. Heald, Gen. Mgr. C. & W. M. Ry., Grand Rapids, Mich.
 Jno. T. Dye, Esq., Gen. Atty. Big Four Ry., Cincinnati, Ohio.
 Mr. G. W. Parker, Vice Pres. and Gen. Mgr. St. L. A. & T. H. Ry., St. Louis, Mo.
 Mr. C. H. Hudson, Gen. Mgr. East Tenn. V. & G. Ry., Knoxville, Tenn.
 Mr. E. B. Thomas, 1st Vice Pres. N. Y. L. E. & W. Ry., New York, N. Y.
 Mr. A. M. Tucker, Gen. Mgr. N. Y. P. & O. Ry., Cleveland, Ohio.
 Mr. Robert Bell, Gen. Supt. W. N. Y. & P. Ry., Buffalo, N. Y.

Mr. Thos. Reynolds, Supt. C. C. C. & St. L. Ry., Indianapolis, Ind.
Mr. G. A. Collins, Gen. Supt. Monon Ry., Chicago, Ill.
Mr. G. K. Sutton, Gen. Supt. C. C. C. & St. L. Ry., Connorsville, Ind.
Mr. J. W. Thomas, Pres. and Gen. Mgr. N. C. & St. L. Ry., Nashville, Tenn.
Mr. F. W. Tracy, Pres. O. & M. Ry., Cincinnati, Ohio.
Mr. D. J. Mackey, Pres. P. D. & E. Ry., Evansville, Ind.
Mr. J. H. P. Hugart, Gen. Mgr. G. R. & I. Ry., Grand Rapids, Mich.
Mr. R. B. Pogrom, Supt. M. & C. Ry., Memphis, Tenn.
Clark Bell, Esq., Ed. Medico-Legal Journal, New York, N. Y.
Landon B. Edwards, M. D., Ed. Virginia Medical Monthly, Richmond, Va.
Mr. A. W. Johnston, Gen. Supt. N. Y. C. & St. L. Ry., Cleveland, O.
John B. Lundy, M. D., Surg. G. T. Ry., Preston, Ont. Can.
Henry G. Stemen, Delphos, Ohio.
Mr. A. K. Van Horne, Jerseyville, Ill.
Chas. W. Hitchcock, M. D., Chief Surg. of the Standard Life & Accident Insurance Company, Detroit, Mich.



Mortality Roll for 1888 to 1891 inclusive.

Dr. A. W. Bariteau,	Oberlin, Kan.
Dr. D. P. Bigger,	Brainerd, Minn.
Dr. W. F. Beard,	Vincennes, Ind.
Dr. J. H. Calkings,	Davis City, Neb.
Dr. Daniel Duckett,	Forest, Ill.
Dr. S. P. Grill,	Orrville, Ohio.
Dr. D. J. Holland,	Atchison, Kan.
Dr. J. W. Jackson,	Kansas City, Mo.
Dr. E. L. Lathrop,	Ottumwa, Ia.
Dr. E. L. Morton,	Vernon, Ala.
Dr. F. C. McConnelly,	Vermillion, Ohio.
Dr. D. D. Marr,	Chesterton, Ind.
Dr. Benj. Newland,	Bedford, Ind.
Dr. David Prince,	Jacksonville, Ill.
Dr. A. W. Ridenour,	Massillon, Ohio.
Dr. C. V. Rockwell,	Taylorville, Ill.
Dr. Caleb B. Sipple,	Sedan, Kan.
Dr. P. Van Patton,	Forest City, Ark.
Dr. Jesse N. Wilson,	Sumner, Ia.
Dr. Frank J. Weed,	Cleveland, Ohio.
Dr. J. B. Cummings,	Forrest City, Ark.
Dr. W. F. Gallaway,	Eau Clair, Wis.
Dr. B. M. Hughes,	Birmingham, Ala.
Dr. J. Jones,	Auburn Park, Ill.
Dr. John W. McMillen,	Columbus, Ohio.
Dr. W. F. Peck,	Davenport, Ia.
Dr. Ed. N. Small,	Seladia, Mo.
Dr. Benj. Willson,	Higginsville, Mo.

Mortality Roll for 1892.

Dr. A. L. Burson,	Ft. Scott, Kan.
Dr. C. L. Chandler,	Lenox, Mich.
Dr. S. B. Chilton,	St. Albans, W. Va.
Dr. T. C. Green,	Hornellsville, N. Y.
Dr. J. H. Hunt,	Port Jervis, N. Y.
Dr. W. H. Henderson,	Kingston, Ont., Can.
Dr. C. M. Martin,	Sunbury, Pa.
Dr. A. B. Reed,	Cedar Rapids, Ia.
Dr. S. B. Taylor,	Blair, Neb.
Dr. S. T. Williams,	Kendallville, Ind.
Dr. B. A. Watson,	Jersey City, N. J.
Dr. J. E. Halbert,	Mound Lodge, Miss.
Dr. John C. Hanay,	Tucson, Ariz.
Dr. Wm. N. McCoy,	Jeffersonville, Ind.

Mortality Roll for 1893.

Dr. M. J. Baker,	Hornellsville, N. Y.
Dr. Henry Ristine,	Cedar Rapids, Ia.
E. W. Harvey,	Bancroft, Mich.

Roll of Active Members up to December 1st, 1893.

Adair, J. H., Owatonna, Minn.	C. & N.	1890
Ames, A. A., 424 Nicollet Ave., Minneapolis, Minn.	M. St. P. S. S. M.	1888
Atwell, W. F., Stevens' Point, Wis.	N. P.	1892
Agnew, Alex W., Fayette, C. H., Ala.	R. & D.	1891
Ayres, Samuel, 31 Times Bldg., Kansas City, Mo.	K. C. O. & S.	1891
Alexander, J. T., Girard, Kan.	K. C. F. S. & M.	1889
Asadoorian, H. B., Castle Gate, Utah.	R. G. W.	1893
Adams, J. I., Scotland, S. D.	C. M. & St. P.	1893
Allen, H. B., Cloquet, Minn.	D. & W.	1893
Anderson, Jno. R., Martinsville, Va.	Asst. Chief N. & W.	1892
Ady, Emmett, West Liberty, Ia.	B. C. R. & I.	1892
Allen, Hamilton, 1108 Pacific Ave., Tacoma, Wash.	N. P.	1893
Archer, J. D., Holgate, Ohio.	B. & O.	1891
Anderson, Thos. E., Statesville, N. C.	R. & D.	1891
Axline, J. D., Shawnee, O.	Chief C. S. & H.	1892
Albertson, Wm. C., Belvidere, N. J.	L. & H.	1893
Allen, E. P., Stillman Valley, Ill.	C. M. & St. P.	1892
Alderman, W. N., Athens, O.	B. & O. S. W.	1891
Acheson, A. W., Dennison, Tex.	M. K. & T.	1890
Allen, Richard W., Dallas, Tex.	M. K. & T.	1890
Armstrong, E., Greenleaf, Kan.	Cent. Branch M. P.	1890
Alt, Adolf, 3036 Locust St., St. Louis, Mo.	Occulist M. P.	1890
Alley, Wm. H., Forest City, Ark.	St. L. I. M. & S.	1891
Alting, D. G., Dunkirk, N. Y.	L. S. & M. S.	1891
Appley, Wm. W., Cochection, N. Y.	N. Y. L. E. & W.	1891
Annis, E. L., La Porte, Ind.	L. E. & W.	1890
Anderson, A. B., Pawnee, Neb.	C. R. I. & P.	1891
Anthony, Frank, Sterling, Ill.	C. & N. W.	1891
Ainsworth, F. K., Los Angeles, Cal.	S. P. Div.	1891
Adair, A. W., Kellogg, Ia.	C. R. I. & P.	1891
Aloe, L. P., 3741 Pine St., St. Louis, Mo.	M. P.	1891
Aldrich, D. W., Galesburg, Ill.	C. B. & Q.	1892
Arthur, C. S., Portland, Ind.	G. R. & I. Div.	1892
Adams, John C., West Superior, Wis.	U. P.	1892
Alderson, M. E., Russellville, Ky.	L. & N.	1892
Allee, W. S., Olean, Mo.	M. P.	1892
Adams, R. J., Morrilton, Ark.	S. L. I. M. & S.	1892
Arbogast, B. A., Breckenridge, Col.	Asst. U. P.	1892
Alexander, Reid, 622 Kansas Ave., Topeka, Kan.	C. R. I. & P.	1893
Ainey, David C., New Milford, Pa.	Asst. D. L. & W.	1893
Annmerman, C. R., Colorado City, Col.	Asst. Col. Mid.	1893
Blaisdell, Geo. C., Contoocook, N. H.	B. & M.	1891
Brush, Edmund C., Zanesville, O.	C. & M. V.	1890
Brodnax, J. G., Greensboro, N. C.	R. & D.	1891
Bennett, J. W., Brookhaven, Miss.	L. C.	1892
Bennett, Robt. S., Drexel, Mo.	K. C. P. & G.	1892
Brett, B. C., Green Bay, Wis.	C. & N. W. Dist	1891
Bell, Geo. M., Benton Harbor, Mich.	Big Four.	1892
Burford, Hugh, Brunswick, Ga.	E. T. V. & G.	1891
Bagby, Oliver, Vinita, I. T.	M. K. & T.	1890
Boynton, S. R., Sparta, Ill.	M. & O.	1892
Borroun, A. J., Corinth, Miss.	M. & O.	1892
Bremerman, L. T., Downingtown, Pa.	Penna.	1890
Bennett, Josiah H., Wauseon, O.	L. S. & M. S.	1888
Bromwell, J. E., Mt. Airy, Md.	B. & O.	1892
Brown, J. E., McConnellsville, O.	Z. & O.	1891
Beebe, Warren L., St. Cloud, Minn.	N. P.	1891
Boatner, T. P., Pottscamp, Miss.	K. C. M. & B.	1891
Brooks, J. C., Oakwood, Miss.	L. N. O. & T.	1891
Brown, H. M., 418 Jefferson St., Milwaukee, Wis.	C. M. & St. P.	1892
Brown, H. B., Lincoln, Ill.	P. D. & E.	1890
Bradner, Henry K., Warwick, N. Y.	Chief L. & H. R.	1892
Boyd, J. R., Butler, Mo.	M. P.	1893
Boise, Eugene, Grand Rapids, Mich.	Asst. G. R. & I.	1892
Brown, A. J., Higbee, Mo.	Asst. Div. C. & A.	1892
Bevan, A. D., Portland, Ore.	U. P. Div.	1891
Barrell, Chas. C., Galveston, Tex.	I. & G. N.	1891
Brown, M. S., Danville, Ill.	C. C. C. & St. L.	1891
Burns, Reed, Honesdale, Pa.	D. & H.	1892

Brigham, C. B., San Francisco, Cal.	S. P.	1892
Budge, W. H., Marshfield, Wis.	C. & N. W.	1892
Beasley, Geo. F., Lafayette, Ind.	Asst. Wabash.	1888
Beach, J. N., West Jefferson, O.	P. C. & St. L.	1888
Bennett, W. P., Crestline, O.	P. Ft. W. & C.	1888
Barth, Louis, Grand Rapids, Mich.	Asst. C. & N. W.	1888
Brock, C. W. P., 206 E. Franklin St., Richmond, Va.	Chief C. & O.	1888
Booth, David S. Jr., 500 N. Jefferson Ave., St. Louis, Mo.	Const. I & G. N.	1888
Boles, Emil, Dayton, Wash.	O. & W. T.	1888
Barney, Reuben, Chillicothe, Mo.	C. M. & St. P. Div.	1889
Bradshaw, Jno. F., Superior, Neb.	M. P.	1889
Bain, Frank D., Kenton, O.	C. & A.	1889
Beggs, G. W., Sioux City, Ia.	I. C.	1889
Boulware, T. C., Butler, Mo.	M. P.	1889
Buchanan, J. G., Allegheny, Pa.	Penna.	1889
Buchard, C. T., Falls City, Neb.	M. P.	1889
Buckley, Jno. J., Missoula, Mont.	Chief N. P.	1889
Bullock, Frank E., Forest City, Mo.	K. C. St. J. & C. B.	1889
Burke, Jno. P., California, Mo.	M. P.	1889
Bryan, J. D., Ottawa, Kan.	M. P.	1889
Buechner, W. L., Youngstown, O.	N. Y. L. E. & W.	1889
Bishop, W. T., 211 Pine St., Harrisburg, Pa.	Med. Ex. Penna.	1889
Barber, A. W., Cheyenne, Wyo.	F. E. & M. V.	1890
Begley, B. W., Inglesfield, Ind.	E. & T. H.	1890
Breed, F. L., Seward, Neb.	F. E. & M. V.	1890
Bush, J. C. F., Wahoo, Neb.	Asst. U. P.	1890
Bloomfield, R. G., Toledo, Ill.	P. & D. E.	1890
Blakeslee, Wm. R., Forest City, Pa.	N. Y. L. E. & W.	1891
Boardman, Chas. V., 1104 Maryland Ave. S. W., Washington, D. C.	P. W. & B.	1891
Birdsall, Sam'l, Susquehanna, Pa.	N. Y. L. E. & W.	1891
Bryant, D. C., 15th and Dodge St., Omaha, Neb.	Oculist U. P.	1891
Buechner, W. H., Youngstown, O.	N. Y. L. E. & W.	1891
Baldwin, M. A., Cuthbert, Ga.	S. W.	1891
Bizzell, F. A., Arcola, Miss.	L. N. O. & T.	1891
Bouffleur, A. L., 738 Washington Boule- vard, Chicago, Ill.	C. M. & St. P.	1891
Banwell, W. H., Orleans, Neb.	B. & M. R.	1891
Burd, Edwin, Lisbon, Ia.	C. & N. W.	1891
Bell, Sam'l, Beloit, Wis.	C. & N. W.	1891
Bear, Alexander, Norfolk, Neb.	Asst. U. P.	1891
Bergen, A. C., Sioux City, Ia.	C. St. P. M. & O.	1891
Budd, J. D., Two Harbors, Minn.	Chief D. & I. R.	1891
Boggs, A. D., Marquez, Tex.	I. & G. N.	1891
Bradford, T. S., Augusta, Ky.	C. & O.	1891
Buckley, Benj. T., Freeport, Ill.	C. & N. W.	1891
Bell, Frank M., Kells, Wash.	N. P.	1891
Bowen, Asa B., Maquoketa, Ia.	C. & N. W.	1891
Boardman, H. P., Oakes, N. D.	N. P.	1891
Brayton, Chas. E., Stonington, Conn.	Ex-Chief N. Y. P. & B.	1891
Brannan, T. H., Canal Dover, O.	C. L. & W.	1891
Bley, Geo., Jr., Beardstown, Ill.	O. & M.	1891
Branch, W. G., Bunker, La.	T. & P.	1891
Blackmer, F. A., Albert Lea, Minn.	M. & St. L.	1891
Brawley, M. A., Frankfort, Kan.	M. P.	1891
Eyers, Jno. E., Butler, Pa.	Penna.	1891
Bovle, J. J., Susquehanna, Pa.	N. Y. L. E. & W.	1891
Barnett, Jas. R., Neenah, Wis.	C. & N. W.	1891
Bailey, D. L., Carbondale, Pa.	Asst. D. & H. C.	1891
Bradley, Robt. D., 303 Main St., Peoria, Ill.	P. D. & E.	1891
Butler, Theo. E., Glen Allen, Miss.	L. N. O. & T.	1891
Boyd, Montague L., Savannah, Ga.	Chief S. B.	1892
Bumbaugh, A. B., Huntingdon, Pa.	Penna.	1892
Blanton, Geo. W., Chauncey, Ga.	E. T. V. & G.	1892
Bean, Watson W., Rolfe, Ia.	C. R. I. & P.	1892
Blighton, W. V. R., Tonawanda, N. Y.	N. Y. L. E. & W. Div.	1892
Barlott, I. C., Hooversville, Pa.	B. & O.	1892
Bowman, Alfred R., Sabin, Tex.	S. P.	1892
Belt, Chas., Batavia, O.	C. P. & V.	1892
Belcher, C. E., Munson's Station, Pa.	Beech Creek.	1892
Brackline, W. A., Higginsville, Mo.	M. P.	1892
Brady, L. M., Oxford, Neb.	B. & M. R.	1892
Bishop, L. A., Fond du Lac, Wis.	C. & N. W.	1892
Brundage, Alfred H., Xenia, O.	P. C. C. & St. L.	1892
Brown, Caleb, Sac City, Ia.	C. & N. W.	1892
Bond, L. L., Westside, Ia.	C. & N. W.	1892
Bacon, J. E., Waukesha, Wis.	C. & N. W.	1892
Byers, Frederick W., Monroe, Wis.	Ill. Cent.	1892
Burnside, S. H., Wichita Falls, Tex.	F. W. & T.	1892
Beard, J. S., Troy, Ala.	Cent. of Ga.	1892
Blythe, S. G., Nora Springs, Ia.	B. C. R. & N.	1892

Brucker, Chas. M., Tell City, Ind.	L. E. & St. L.	1892
Bogle, W. H., Atchison, Kan.	Asst. A. T. S. F.	1892
Barringer, J. C., Oskaloosa, Ia.	I. C.	1891
Barrett, W. H., Harrisonville, Mo.	M. P.	1889
Burnett, J., Scranton, Pa.	D. & H.	1891
Bancroft, F. J., Denver, Colo.	Chief R. G. W.	1889
Baxter, G. A., Chattanooga, Tenn.	E. T. V. & G. Div.	1889
Blalock, W. C., Kosse, Tex.	H. & T. C.	1891
Butler, M. M., Bristol, Tenn.	Chief S. A. & O.	1892
Bedell, C. V., Lamar, Colo.	A. T. & S. F.	1892
Brian, F. N., Boyce, La.	T. & P.	1891
Best, A. J., Centalla, Kan.	M. P.	1889
Benjamin, Dowling, Camden, N. J.	Chief C. & A.	1891
Baldwin, G., Ruthven, Ia.	C. R. I. & P.	1891
Burriss, W. F., Sidney, Ill.	Wabash.	1889
Baker, R. B., Hickory, N. C.	R. & D.	1891
Barnes, Henry L., Ripon, Wis.	C. M. & St. P.	1893
Blaisdell, W. S., Punxsutawney, Pa.	B. H. & P.	1893
Buck, E. J., Platteville, Wis.	C. M. & St. P.	1893
Butts, Robert M., Gordon, Ga.	Cent. Ry. of Ga.	1893
Bascom, Horace, Uxbridge, Ont., Can.	G. T. Dist.	1893
Brown, F. G., Hutchison, Kan.	C. R. I. & P.	1893
Bass, Japtha D., Pittsburg, Tex.	E. L.	1893
Browne, Alfred L., Cornwall on Hudson, N. Y.	N. Y. O. & W.	1893
Breck, Theo. F., Springfield, Mass.	B. & A.	1892
Bone, H. C., Grand River, Ia.	H. & S.	1892
Bell, A. K., Madison, Ga.	Ga.	1892
Becknap, Simeon, Niles, Mich.	C. C. C. & St. L.	1892
Baker, J. P., Findlay, O.	L. E. & W.	1892
Bliss, E. W., Hiawatha, Kan.	St. J. & G. I.	1893
Black, R. S., Ottawa, Kan.	A. T. & S. F.	1893
Barton, Thos. J., Zanesville, O.	C. C. & S.	1893
Blackburn, E. C., Wayside, Miss.	Y. M. & V.	1893
Boner, Thos. T., Tupelo, Miss.	M. & O.	1893
Burrell, Henry L., 15th and Dodge Sts., Omaha, Neb.	Oculist U. P.	1893
Bond, J. F., Scott City, Kan.	M. P.	1893
Bruce, Wm. W., Casey, Ill.	C. & O.	1893
Briggs, Thos. H., Battle Creek, Mich.	C. J. & M.	1893
Brockett, Frank L., Shenandoah, Pa.	O. & St. L.	1893
Boughton, F. H., Walcottville, Ind.	Wabash.	1893
Burton, G. W., Mitchell, Ind.	O. & M.	1893
Brooks, W. W., Stanberry, Mo.	O. & St. L.	1893
Bryans, R. G., Jackson, Ga.	E. T. G. & V.	1893
Berry, R. P., Clermont, Ia.	B. C. R. & N.	1893
Brown, E. N., Marengo, Ia.	C. R. I. & P.	1893
Baker, C. A., Yaphank, N. Y.	Long Island.	1893
Burwell, E. E., Goodland, Kan.	C. R. I. & P.	1893
Bell, Henry S., Kearney, Neb.	K. & B. H.	1893
Bailey, S., Mt. Ayr, Ia.	C. & G. N.	1893
Bohannon, J. G., Greenville, Ky.	N. N. & M. V.	1893
Borst, Elman H., Newburg, N. Y.	N. Y. W. S. & B.	1893
Brown, Geo. H., Chanute, Kan.	M. K. & T. Div.	1892
Conna, G. P., Concord, N. H.	Chief C. & M.	1888
Chapman, W. A., Hastings, Neb.	B. & M. R.	1888
Campbell, T. B., West Lebanon, Ind.	Wabash.	1888
Crouse, D. W., Waterloo, Ia.	Ill. Cent.	1888
Carr, E. C., Coshocton, O.	P. C. C. & St. L.	1888
Caldwell, F. H., Sanford, Fla.	Chief S. F.	1888
Cokenower, Harvey L., Clarinda, Ia.	C. B. & Q.	1889
Courtney, Walter, Brainerd, Minn.	Chief N. P.	1889
Coit, Geo. W., Missouri Valley, Ia.	Chief F. E. & M. V.	1889
Cole, Chas. K., Helena, Mont.	Chief M. C.	1889
Cory, A. L., 4136 Wabash Ave, Chicago, Ill.	L. S. & M. S.	1890
Christopher, D. I., Colorado Springs, Col.	C. R. I. & P.	1890
Chenoweth, W. J., Decatur, Ill.	P. D. & E.	1890
Cooper, H. P., 34 Peachtree St., Atlanta, Ga.	Chief A. & W. P.	1891
Cummings, D. S., Waseca, Minn.	C. & N. W.	1891
Cavana, Martin, Oneida, N. Y.	N. Y. O. & W.	1891
Calkins, H. T., Petoskey, Mich.	G. R. & I. Div.	1891
Chaffee, Geo., 223 47th St., Brooklyn, N.Y.	Long Island.	1890
Charles, Joseph, Newport News, Va.	C. & O.	1891
Chalker, W. R., Lake City, Fla.	F. C. & R.	1891
Carleton, Wellington, Rochelle, Ill.	C. & N. W.	1891
Crain, F. M., Doland, S. D.	C. & N. W.	1891
Clark, L. A., Rockford, Ill.	I. C.	1891
Cyrus, Wm. H., Palatka, Fla.	J. T. & K. W.	1891
Chitwood, Joshua, Connersville, Ind.	C. C. C. & St. L.	1891
Crain, F. W., Sheldon, Ia.	C. St. P. M. & O.	1891
Clark, P. J., Oakland, Neb.	C. St. P. M. & O.	1891
Canfield, Owen B., Edgar, Neb.	B. & M. R.	1891
Cowels, A. G., Durand, Mich.	G. T.	1891

Campbell, R. F., Watertown, S. D.	C. & N. W.	1891
Crawford, Thos. A., Rockhill, S. C.	R. & D.	1891
Casey, Wm. N., Seymour, Ind.	O. & M.	1891
Cunningham, W. M., Corona, Ala.	R. & D.	1891
Cox, Joseph J., High Point, N. C.	R. & D.	1891
Cavaney, James, 409 Grand Ave, Milwaukee, Wis.	W. C.	1892
Cooley, J. M., Beechtree, Pa.	B. R. & P.	1892
Cuddeback, W. L., Port Jervis, N. Y.	N. Y. L. E. & W.	1892
Carr, M. A. R. F., Cumberland, Md.	B. & O.	1892
Cole, A. Jerome, Brett, Ia.	M. & St. L.	1892
Clark, Eugene, Lockhart, Tex.	M. K. & T.	1892
Corwith, Silas R., Bridgehampton, N. Y.	L. I.	1892
Cartwright, J. W., Payne, O.	N. Y. C. & St. L.	1892
Chandler, H. S., Canadian, Tex.	Santa Fe.	1892
Cowan, D. W., Hinckley, Minn.	E. M. & G. N.	1892
Cobb, H. H., Goldboro, N. C.	W. & W.	1892
Creel, M. P., Central City, Ky.	N. N. & M. V.	1892
Carter, Jas., Carbon, Wyo.	U. P.	1892
Crawford, A. J., Gloucester, O.	T. & O. C.	1892
Curry, J. H., Toledo, O.	F. St. L. & K. C.	1892
Clymer, H. V., Huntington, Ore.	Asst. U. P.	1892
Coulter, C. W., Oil City, Pa.	W. N. Y. & P.	1892
Cleveland, J. C., Bald Knob, Ark.	St. L. I. M. & S.	1893
Cox, Ross P., Rome, Ga.	Cent. of Ga.	1893
Connell, M. E., Wauwatosa, Wis.	C. M. & St. P.	1893
Craig, W. E., Osawatonna, Kan.	M. P.	1893
Clark, Anson T., Greenville, Pa.	N. Y. P. & O.	1893
Coyne, S. J., Aberdeen, S. D.	C. M. & St. P.	1893
Carpenter, E. M., Omaha, Neb.	Asst. Chief U. P.	1893
Cox, J. B., Belle Plain, Ia.	C. & N. W. Dist.	1893
Clark, E. W., Grinnell, Ia.	C. R. L. & P.	1893
Caldwell, Wm., Fremont, Ohio.	L. S. & M. S.	1891
Connor, H. J., West Superior, Wis.	S. P.	1888
Clark, Isaac E., Schulenberg, Tex.	Erle.	1891
Crandall, G. D., Blossburg, Pa.	B. & O.	1892
Campbell, M., Parkersburg, W. Va.	N. P.	1891
Chapple, Henry, Billings, Mont.	Cent. Pac.	1891
Curless, Wm., Truckee, Cal.	N. Y. C. & St. L.	1892
Crile, Geo. W., 380 Pearl St., Cleveland, O.	W. C.	1893
Caine, Wm. H., 1314 S. 3d St., Stillwater, Minn.	M. P.	1891
Connett, A. H., Great Bend, Kan.	C. R. I. & P.	1892
Criley, B. H., Dallas Center, Ia.	A. & P.	1893
Cornish, P. G., Flagstaff, Ariz.	Asst. Chief C. & O.	1893
Clyne, Jas. A., Joliet, Ill.	C. M. & St. P.	1893
Cool, D. M., Faribault, Minn.	S. & C. S. L.	1893
Crane, A. Melville, Marion, Ohio.	Ala. Mid.	1893
Collier, J. M., Troy, Ala.	Chief C. & C.	1893
Counsellor, Chas. Eyre, Hawthorne, Neb.	C. M. & St. P.	1892
Clark, A. L., Elgin, Ill.	L. S. & M. S.	1888
Chapman, Geo., Hudson, Mich.	Northern.	1892
Cooper, H. M., New Westminster, B. C.	A. C. L.	1891
China, Archie, Sumter, S. C.	W. & L. E.	1891
Calvin, J. H., Huron, O.	N. & C.	1892
Culpepper, V. G., Portsmouth, Va.	B. & O.	1891
Cook, John R., Montana Mines, W. Va.	C. B. & Q.	1891
Cook, Edgar P., Mendota, Ill.	D. & R. G.	1892
Corwin, R. W., Pueblo, Colo.	Penna.	1893
Craig, Alexander, Columbia, Pa.	C. M. & St. P.	1892
Cutter, J. D., Tomahawk, Wis.	T. & P.	1892
Cooper, St. Cloud, Jefferson, Tex.	B. C. R. & N.	1893
Clark, A. H., Ellsworth, Minn.	S. P. Div.	1892
Cox, Geo. W., Brownsville, Ore.	N. P.	1891
Coe, Henry W., Portland, Ore.	N. & W.	1892
Cowan, R. H., Radford, Va.	P. F. W. & C.	1889
Craig, W. H., Freedom, Pa.	Ft. W. & D. C.	1892
Cristler, J. H., Childress, Tex.	C. A. & C.	1890
Childs, O. D., Akron, O.	I. C.	1891
Cornelly, J. W., Farmington, Ill.	P. & L. E.	1890
Clark, A. M., Youngstown, O.	C. & O.	1892
Call, A. J., Norwood, Va.	D. & R. G.	1891
Chapman, Norman A., Monte Vista, Colo.	Asst. Mex. Cent.	1892
Carr, A. N., Coalma, Jeniluco, Mex.	P. V. W. & C. Div.	1893
Chesney, John A., Bucyrus, O.	Asst. Chief Wabash.	1893
Clapp, C. B., Moberly, Mo.	P. C. C. & St. L.	1893
Casey, H. R., Austin, Ind.	U. P.	1893
Chipman, J. C., Sterling, Col.	S. F.	1893
Dwelly, G. A., Tampa, Fla.	W. & B.	1891
Dyer, D. A., St. Peters, Mo.	G. B. W. & St. P.	1892
Dale, Geo., Iola, Wis.	Asst. U. P.	1890
Daugherty, P., Junction City, Kan.	R. & D.	1890
Day, Wm. C., Danville, Va.		

Dodge, F. A., Le Sueur, Minn.	C. St. P. M. & O.	1891
Dye, A. A., 218 Pinkney N., Madison, Wis.	M. P.	1889
Dickey, Wm. T., Vernon, Tex.	U. P.	1891
Derring, A. A., Boone, Ia.	C. & N. W. Dist.	1888
Dewey, Geo. M., Keytesville, Mo.	W. & W.	1888
Damerell, Robert, Red Cloud, Neb.	B. & M. R.	1889
Donnell, T. C., Franklin, Ind.	P. C. C. & St. L.	1889
Dinnen, J. M., Ft. Wayne, Ind.	Chief N. Y. C. & St. L.	1890
Doyle, O. M., Seneca, S. C.	R. & D.	1890
Dryden, R. C., Winslow, Ariz.	A. & P.	1890
Dunham, J. D., Pattonsburg, Mo.	Wabash.	1890
Drake, N. A., 1001 Harrison St., Kansas City, Mo.	C. R. I. & P.	1890
Dale, J. R., Arkadelphia, Ark.	Chief U. T. A. & M.	1890
Duncan, J. A., Toledo, O.	Wabash Div.	1890
Daniels, C. M., Buffalo, N. Y.	N. Y. L. E. & W.	1891
Donnan, E. A., New Castle, Pa.	P. & L. E.	1891
Day, Dwight W., Eau Claire, Wis.	C. M. & St. P.	1891
Davis, F. F., Oil City, Pa.	A. V.	1891
Dample, C. E., Crookston, Minn.	G. N. & N. P.	1891
Darr, Hiram H., Caldwell, Tex.	G. C. & S. F.	1891
Doane, Osmon D., The Dallas, Ore.	Asst. U. P.	1891
Dodge, Amos P., Onelda Castle, N. Y.	W. S.	1891
Dickinson, Dan I. K., Lead City, S. D.	Chief B. H. & Ft. P.	1891
Davis, Wm. H., Maquoketa, Ia.	C. M. & St. P.	1891
Dean, Geo. R., Spartanburg, S. C.	R. & D.	1891
Daniels, W. N., Mosinee, Wis.	C. M. & St. P.	1891
Doerr, J. E., Terre Haute, Ind.	E. & T. H.	1891
Billard, Jno. W., Lynchburg, Va.	N. & W.	1891
Darrow, E. W., Fargo, N. D.	G. N.	1891
Davega, S. M., Chester, S. C.	R. & D.	1891
Dick, F. N., North Platte, Neb.	Asst. U. P.	1891
Dent, Wm. M., Newburgh, W. Va.	B. & O. Div.	1892
Dixon, John N., Springfield, Ill.	C. & A.	1892
Dodson, N. M., Berlin, Wis.	C. M. & St. P.	1892
In Hadway, C., Jerseyville, Ill.	Chief St. L. C. & St. P.	1892
Davenport, H. E., Sheridan, Ind.	L. N. A. & C.	1892
Drayer, Peter, Hartford City, Ind.	L. E. & W.	1892
Davis, B. B., McCook, Neb.	B. & M. R.	1892
Dunn, A. A., Purcell, Ind. Ter.	A. T. & S. F.	1892
Davis, Jno. F., Oil City, Pa.	A. V.	1892
Dawson, Jas. H., Marquette, Mich.	D. S. S. & A.	1892
Divver, R. F., Anderson, S. C.	R. & D.	1892
Dearborn, R. F., Lynn, Mass.	B. R. R. & L.	1892
Dayton, W. L., Lincoln, Neb.	B. & M. R.	1893
Davis, Geo. W., Kansas City, Mo.	K. C. Ft S. & M.	1893
De Tar, D. N., Boone, Ia.	D. M. N. & W.	1893
Dodson, Jno. M., 631 Jackson Boulevard, Chicago, Ill.	W. C.	1893
DeWolf Jas. E., 444 Englewood Ave., Englewood, Ill.	Penna.	1893
Dana, Edward B., Metuchen, N. J.	L. V.	1893
Doig, Robt. L., Ellsworth, Kan.	U. P.	1893
Douglas, J. H., Jacksonville, Fla.	J. T. & K. W.	1893
Davis, W. B., St. Joseph, Mo.	C. & G. N.	1893
Davis, Rogers, Decker, Ind.	E. & T. H.	1893
De Kalb, B. D., De Kalb, Ia.	H. & S.	1893
Davis, J., New Carlisle, Ind.	L. S. & M. S.	1890
Daily, I. M., Beloit, Kan.	M. P.	1891
Dunott, Daniel Z., 132 Walnut St., Harrisburg, Pa.	Penna.	1893
Dice, J. B. F., Morristown, Tenn.	Chief M. C. & G.	1891
Denney, Wm., Washington, Pa.	B. & O.	1892
De Jernett, W. B., Commerce, Tex.	St. L. & S. W.	1891
Dutton, S. W., McCracken, Kan.	M. P.	1891
Daly, John J., Rahway, N. J.	Penna Cent.	1892
Dundass, Robert C., Grand Rapids, Mich.	C. & W. M. Div.	1891
Deahofe, S. P., Mineral Pt., Wis.	C. M. & St. P.	1893
Duncan, Wm. E., Aberdeen, S. D.	G. N.	1893
Dean, J. G., Dawson, Ga.	Cent. Ry. of Ga.	1893
Eddy, J. H., Wakefield, Mich.	D. S. S. & A.	1891
Eddie, J. Orton, Grand Rapids, Mich.	L. S. & M. S.	1891
Ellenwood, A. G., Artica, N. Y.	N. Y. L. E. & W.	1891
Evans, John M., Evansville, Wis.	C. & N. W.	1891
Emmert, J. M., Atlantic, Ia.	C. R. I. & P.	1892
Ellis, Wm. E., Prentice, Wis.	W. C. & S. L.	1891
Epley, F. W., New Richmond, Wis.	C. St. P. M. & O.	1891
Evans, Franklin J., Chester, Pa.	B. & O.	1891
Evans, W. J., Gorton, S. D.	C. M. & St. P.	1891
Ewing, W. M., Ottawa, Kan.	Santa Fe.	1892
Earle, G. W., Hermansville, Mich.	M. St. P. & S. S. M.	1892
Enfield, Chas., Jefferson, Ia.	C. & N. W.	1891
Engle, Theo., State Center, Ia.	C. & N. W.	1891

Ettneueller, G., Herman, Mo.	M. P.	1891
Elkin, W. S., Atlanta, Ga.	R. & D.	1892
Emerson, Geo., Winfield, Kan.	A. T. & S. F.	1891
Evans, Robert M., Minto, N. D.	G. N.	1893
Estes, N. D., Alamosa, Colo.	D. & R. G.	1891
Evans, E. B., Greencastle, Ind.	C. C. C. & St. L.	1888
Everett, M. H., Lincoln, Neb.	Asst. B. & M. R.	1888
Evans, F. R., Franklin, O.	C. C. C. & St. L.	1888
Ewh, Geo., Talmage, Neb.	M. P.	1889
Eads, B. F., Marshall, Tex.	Chief T. & P.	1889
Eschbach, H. C., Albia, Ia.	Ia. Cent.	1889
Elliot, Wm. H., Savannah, Ga.	Chief Cent. of Ga.	1889
Earle, Thos. T., Greenville, S. C.	R. & D.	1890
Eddy, J. W., Oswego, N. Y.	Ex-Chief C. W. & O.	1890
Eberhard, E. L., South Whitley, Ind.	N. Y. C. & St. L.	1891
English, J. E., Baraboo, Wis.	C. & N. W. Dist.	1891
Evans, C. D., Columbus, Neb.	B. & M. R.	1891
Estes, Wm. L., S. Bethlehem, Pa.	Chief L. V.	1891
Edwards, A. G., Marysville, Kan.	Asst. U. P.	1891
Everhard, W. H., Volga, S. D.	C. & N. W.	1891
Entricken, F. W., Findlay, O.	T. C. & C.	1891
Eastland, Jno. S., Judsonia, Ark.	St. L. I. M. & S.	1891
Ewing, W. P., Charleston, W. Va.	C. & O.	1891
Ewart, Chas. R., Logan, Kan.	M. P.	1891
Erwin, B. S., Mauch Chunk, Pa.	L. V.	1891
Eddy, W. J., Shelbyville, Ill.	C. & E. I.	1891
Ehrhardt, H., Beardstown, Ill.	C. B. & Q. Div.	1891
Engberg, A., McPherson, Kan.	M. P.	1891
Elliot, A. B., Vanceburg, Ky.	C. & O. Div.	1892
Ellison, M. D., Canister, N. Y.	N. Y. L. E. & W.	1892
Estill, Andrew W., Lexington, Va.	B. & O.	1892
Essick, W. W., Murphysboro, Ill.	M. & O.	1892
Easley, Wm. T., Greenville, Ill.	St. L. V. & T.	1892
Ellis, S. A., Staples, Minn.	N. P.	1892
Ensign, Wm. O., Rutland, Ill.	Ill. Cent.	1892
Elliot, Howard R., Brucefield, Ont., Can.	G. T.	1892
Ellmore, Chas. G., Gordon, Neb.	F. E. & M. V.	1893
Epperson, J. C., Kansas, Ill.	C. & O. R.	1893
Ebright, L. S., Akron, O.	C. A. & C.	1893
Essig, N. Fred, Spokane, Wash.	N. P.	1893
Eddy, John L., Olean, N. Y.	W. N. Y. & P.	1893
Eve, Paul F., 700 Church St., Nashville, Tenn.	L. & N.	1893
Ewing, John H., Flemington, N. J.	P. & R.	1893
Finney, Frank, La Junta, Colo.	Santa Fe.	1893
Fouts, Edwin R., Cedar Vale, Kan.	M. P.	1893
Findley, Wm. M., Altoona, Pa.	A. C. & N.	1891
Free, Spencer M., Du Bois, Pa.	B. R. & P.	1891
Fite, Francis B., Muscogee, I. T.	M. K. & T.	1892
Fitzgerald, O. D., Los Angeles, Cal.	Chief S. C.	1891
Fairchild, D. S., Clinton, Ia.	C. & N. W. Div.	1888
Firestone, W. W., Wooster, O.	Penna.	1888
Ford, J. H., Wabash, Ind.	Chief C. W. & M.	1888
Field, J. T., Ft. Worth, Tex.	Chief F. W. & R. G.	1889
Finney, John, Clintonville, Wis.	M. L. S. & W.	1889
Fernandez, J. D., Jacksonville, Fla.	S. F. & W.	1890
Fry, Chas. B., Mattoon, Ill.	C. C. C. & St. L.	1890
Flexer, L. A., Tamanend, Pa.	L. V.	1891
Fullilove, T. W., Vaiden, Miss.	L. C.	1891
Fisher, C. R. P., Bound Brook, N. J.	L. V.	1891
Fanning, Fred W., Butler, Ind.	Wabash.	1891
Field, Julian C., Denison, Tex.	H. & T. C.	1891
Flick, D. W., Rapid City, S. D.	F. E. & M. V.	1891
Ford, De Saussure, Augusta, Ga.	Chief G. R.	1891
Fox, William, Milwaukee, Wis.	C. & N. W. Dist.	1891
Felch, Theo. A., Ishpeming, Mich.	D. S. S. & A.	1891
Furlong, M., Walthewater, Wis.	C. M. & St. P.	1891
Field, Matthew D., 71 Broadway, New York City, N. Y.	Manhattan.	1892
Freel, S. L., Stouffville, Ont., Can.	G. T.	1892
Fenelon, John H., Norman, Okla. Ty.	A. T. & S. F.	1892
Freeman, Jno. W., Lead, S. D.	B. H. & F. P.	1892
Ferriss, J. H., Henrietta, Tex.	Ft. W. & D.	1892
Fleming, J. C., Burlington, Ia.	C. B. & Q.	1893
Fay, J. R., Topeka, Kan.	A. T. & S. F.	1893
Farrar, M. C., Atchison, Kan.	Asst. Chief M. P.	1893
Felty, J. W., Abilene, Kan.	Santa Fe.	1893
Fowler, E. S., Springfield, Ill.	Chief O & M.	1893
Few, C., Hendersonville, N. C.	A. & S.	1891
Fegers, C. H., McHenry, Ill.	N. W.	1891
Fisher, Oliver, Custer City, S. D.	Past Asst. B. & M. R.	1891
Furniss, John P., 549 Landerdale St., Selma, Ala.	A. & W. P. & W.	1892

Fitts, W. L., Carrollton, Ga.	C. R. R. of Ga.	1891-1893
Franke, A. A., Newton, Ill.	P. D. & E.	1893
Freuche, L., 3d and Brady Sts., Davenport, Ia.	C. M. & St. P.	1893
Fugard, A. L., Pueblo, Colo.	C. R. I. & P.	1893
Fortner, Benjamin F., Vinita, I. T.	M. K. & T.	1893
Guthrie, W. E., Bloomington, Ill.	L. E. & W. Dist.	1891
Gemmill, Jr., J. M., Tyrone, Pa.	Penna.	1892
Geisendorfer, J. A., Arlington, Ore.	U. P.	1891
Gardner, J. B., Girard, Kan.	A. T. & S. F.	1892
Galligher, B. H., Fordyce, Ark.	St. L. & S. W.	1891
Galligher, C. T., Mt. Sterling, O.	B. & O.	1892
Graham, Wm., Brussels, Ont., Can.	G. T.	1893
Gruwell, W., South Bend, Wash.	N. P.	1892
Graves, Cariton, Aitkin, Minn.	N. P.	1891
Genoway, Chas. V., Wallace, Idaho.	N. P.	1892
Gildner, David, Rockwood, Pa.	B. & O.	1891
Godfrey, Henry T., Galena, Ill.	I. C.	1891
Godfrey, Alfred C., Galena, Ill.	C. & N. W.	1892
Graham, W. B., Noblesville, Ind.	L. E. & W.	1892
Gregory, C. L., Yreka, Cal.	S. P.	1892
Gibson, Wm. E., Olney, Wash.	S. L. S. & E.	1892
Garwood, A., New Braunfels, Tex.	I. & N. G.	1891
Gillen, R. H., De Land, Fla.	J. T. & K. W.	1892
Grinstead, W. F., Cairo, Ill.	St. L. I. M. & S.	1888
Greene, J. H., 481 Locust St., Dubuque, Ia.	C. St. P. & K. C.	1888
Gafford, C. C., Wymore, Neb.	B. & M. R. Div.	1888
Gerrish, A. A., Lowell, Ind.	L. N. A. & C.	1888
Gumaer, A. G., 802 Bailey Ave., Buffalo, N. Y.	L. S. & M. S.	1888
Graves, Jas. F., Montgomery City, Mo.	Wabash.	1888
Griffith, J. D., Railroad Building, Kansas City, Mo.	K. C. M. & S. Cons't.	1888
Glereest, J. E., Gainesville, Tex.	M. K. & T.	1889
Goode, Rhett, Mobile, Ala.	M. & O.	1889
Gooden, W. F., Aurora, Neb.	B. & M. R.	1889
Galbraith, W. J., Omaha, Neb.	Chief U. P.	1890
Griswold, L. S., Big Rapids, Mich.	G. R. & I.	1890
Gilbert, J. L., Kendallville, Ind.	G. R. & I. Div.	1890
Graves, A. C., Cherokee, Kan.	K. C. Ft. S. & M.	1890
Greene, Geo. H., Marshall, Mich.	C. J. & M.	1891
Glasgow, S. H., Welland, Can. Ont.	G. T. Dist.	1891
Govan, Wm., Stony Point, N. Y.	W. & S.	1891
Griswold, Elisha, Sharon, Pa.	N. Y. P. & O.	1891
Gates, M. A., Roncverte, W. Va.	C. & O.	1891
Groves, J. E., Ulrichville, Ohio.	C. L. & W.	1891
Goble, Ezra T., Earlville, Ill.	C. & N. W.	1891
Gibbon, Robert, Charlotte, N. C.	R. & D.	1891
Green, W. N., Webster City, Ia.	C. & N. W.	1891
Gibbs, D. C., Crawford, Neb.	F. E. & M. V.	1891
Graves, Amos, San Antonio, Tex.	Chief S. P.	1891
Gaston, Jas. B., Metropolitan, Mich.	C. & N. W.	1891
Geyer, Joseph L., Norwich, O.	B. & O.	1891
Grinnell, A. P., Burlington, Vt.	Chief C. V.	1891
Griswold, Joseph B., Grand Rapids, Mich.	Asst. G. R. & I.	1891
Gillingham, W. P., Almy, Wyo.	Asst. U. P.	1891
Grim, Adam, Franklin Grove, Ill.	C. & N. W.	1891
Glaze, L. Alonzo, Poseyville, Ind.	E. & T. H.	1891
Grayson, F. F., Ft. Dodge, Ia.	M. C. & Ft. D.	1891
Green, Edgar M., Easton, Pa.	L. V.	1891
Gerstell, R., Elk Garden, W. Va.	W. V. C. & P.	1891
Graves, Geo., Herkimer, N. Y.	Chief A. & St. L.	1892
Gillen, R. H., De Land, Fla.	J. T. & K. W.	1892
Gafford, J. A., Buena Vista, Col.	D. & R. G.	1892
Gloninger, Andrew B., Lebanon, Pa.	C. & L.	1892
Gunn, Wm., Clinton, Ont., Can.	G. T.	1892
Grossmann, Paul, 122 S. 17th St., Omaha, Neb.	U. P.	1892
Godfrey, J., Lancaster, Wis.	C. & N. W.	1892
Grant, L. G., Kansas City, Mo.	K. C. Ft. S. & M.	1892
Goben, G. A., Kirksville, Mo.	Wabash.	1893
Goodwin, Joseph A., Jasper, Ala.	B. S. & T.	1893
Grigsby, W. B., Oaktown, Ind.	E. & T. H.	1893
Graham, J. H., Manilla, Ia.	C. M. & St. P.	1893
Guttry, J. D., Valparaiso, Neb.	Asst. U. P.	1893
Gilligar, John P., O'Neill, Neb.	Pac. S. L.	1893
Getz, H. L., Marshalltown, Ia.	C. & N. W.	1893
Gholson, S. C., Jr., Holly Springs, Miss.	I. C.	1893
Gale, Jos. A., Roanoke, Va.	N. & W.	1893
Hayes, John W., Albion, Ind.	B. & O.	1891
Headlee, S. H., St. James, Mo.	St. L. & S. F.	1891
Hubbert, T. J., Hico, Tex.	H. & T. O.	1892

Holmes, A. M., 630 16th St., Denver, Colo.	C. R. I. & P.	1890
Harrison, Geo. W., Ashland, Wis.	W. C.	1891
Hughlett, W. L., Cocoa, Fla.	J. St. A. & I. R.	1892
Hallock, W. E., Juneau, Wis.	C. & N. W.	1892
Heaney, A. G., Corpus Christi, Tex.	S. A. & P. Div.	1892
Hammer, Robert B., Greenburg, Pa.	Penna.	1891
Harrison, B. D., Sault Ste. Marie, Mich.	M. St. P. S. Ste. M.	1891
Hayes, C. A., Chippewa Falls, Wis.	W. C.	1891
Humfreville, Harry, Waterville, Kan.	C. B. M. P.	1892
Harrison, Wm. H., Dublin, Miss.	I. C.	1893
Happel, T. J., Trenton, Tenn.	M. & O.	1893
Holliday, W. S., Monmouth, Ill.	I. C.	1888
Hunter, H. E., Newton, Ia.	Cent. Ia.	1888
Hostetler, W. B., Decatur, Ill.	Consulting, Wabash.	1888
Henderson, A. G., Imboden, Ark.	K. C. Ft. S. & M.	1888
Huselson, W. S., Allegheny, Pa.	P. & W.	1888
Hardy, Neal, Massillon, O.	P. Ft. W. & C.	1888
Hall, J. E., Weeping Water, Neb.	M. P.	1888
Howard, H. C., Champaigne, Ill.	Wabash.	1889
Hobbs, W. R., Elmwood, Neb.	M. P.	1889
Hungate, Jas. B., Weeping Water, Neb.	M. P.	1889
Hudson, M. F., Osborne, Kan.	M. P.	1889
Hamilton, J. M., Verona, Pa.	A. V.	1889
Hall, W. C., Coffeyville, Kan.	M. P.	1890
Highsmith, G. R., Carrollton, Mo.	A. T. & S. F.	1890
Hobson, J. F., Cleveland, O.	Chief C. & P.	1890
Hoegge, G. L., Fostoria, O.	N. Y. C. & St. P.	1890
Humfreville, D. W., Waterville, Kan.	M. P.	1890
Holcomb, C. B., Corning, O.	T. & O. C.	1890
Hall, Geo. N., Binghampton, N. Y.	N. Y. L. E. & W.	1890
Hamilton, S. S., Punksutawney, Pa.	B. R. & P.	1890
Henkle, A. M., Staunton, Va.	C. & O.	1890
Hughart, J. P., Sewell Depot, W. Va.	C. & O.	1890
Hawley, W. H., Penn Yan, N. Y.	N. C.	1890
Hulett, J. B., Middleton, N. Y.	N. Y. O. & W.	1890
Hunt, Jas. G., Utica, N. Y.	N. Y. O. & W.	1891
Hutton, Wm., Elizabeth, Ill.	C. St. P. & K. C.	1891
Hamilton, S. N., Connersville, Ind.	C. H. & D.	1891
Hall, Josiah N., Denver, Col.	Asst. U. P.	1891
Hubbard, C. M., Virginia, Ill.	O. & M.	1891
Hoering, G. P., Walnut, Ia.	C. R. I. & P.	1891
Horn, T. G., Colorado Springs, Col.	Asst. U. P.	1891
Hanawalt, Geo. P., Des Moines, Ia.	Chief D. M. & K. C.	1891
Hundley, J. H., Olney, Ill.	O. & M.	1891
Hixson, Manford, M., Dupont, O.	T. St. L. & K. C.	1891
Hawes, Jesse, Greeley, Col.	U. P.	1891
Hume, Arthur M., Owasso, Mich.	T. A. A. & N. M.	1891
Hildreth, M. L., Lyons, Neb.	C. St. P. M. & O.	1891
Hume, Wm. C., Corunna, Mich.	D. & M.	1891
Hazen, J. M., North Sewichley, Pa.	P. & W.	1891
Haus, Augustus P., New Albany, Ind.	P. C. C. & St. L.	1891
Humbert, G. C., Keithsburg, Ill.	I. C.	1891
Hoge, Wilmer B., Grand Island, Neb.	Asst. U. P.	1891
Henderson, T. R., Greenwood, Miss.	R. & D.	1891
Hanna, J. W., Winfield, Ia.	B. & N. W.	1891
Haptonstall, John J., Stone Cliff, W. Va.	C. & O.	1892
Hollister, G. A., Toledo, O.	L. S. & M. S.	1892
Hopkins, Howard H., New Market, Md.	B. & O.	1892
Harden, R. S., Waverly, N. Y.	N. Y. L. E. & W.	1892
Herrick, Albert B., Lisbon, N. D.	N. P.	1892
Hamilton, N. H., Grafton, N. D.	N. P.	1892
Harris, J. L., Webster, S. D.	C. M. & St. P.	1892
Henry, Chas. W., Coon Rapids, Ia.	C. M. & St. P.	1892
Houston, E., Stanberry, Mo.	Asst. O. & St. L.	1892
Hall, Willis W., Springfield, O.	Chief O. S.	1892
Hathaway, L. B., Reinbeck, Ia.	B. C. R. & N.	1892
Horne, Wm., Mt. Ayr, Ia.	C. B. & Q.	1892
Heller, H. D., Hellertown, Pa.	P. & R.	1892
Hutchins, J. H., Hampton, Ia.	C. & G. W.	1892
Horton, Ferd., New Castle, Wyo.	Asst. B. & M.	1892
Hitchcock, E. W., Goshen, N. Y.	Erie.	1892
Hudson, W. L., Luray, Va.	N. & W.	1892
Hall, R. W., Moundsville, W. Va.	B. & O.	1892
Holland, J. W., Osceola, Ia.	D. M. & K. C.	1892
Henry, C. A., Fostoria, O.	B. & O.	1892
Holliday, J. W., Burlington, Ia.	B. & N. W.	1893
Hargens, C. W., Hot Springs, S. D.	F. E. & M. V.	1893
Haskins, M. H., Kingman, Kan.	A. T. & S. F.	1893
Harris, N. O., Atlanta, Ga.	Chief G. C. & N.	1893
Hutchinson, J. Alex., 515 Wellington, St. Montreal, Que., Can.	Chief G. T.	1893
Hogboom, Geo. W., Topeka, Kan.	Chief A. T. & S. F.	1893
Howes, D. L., South Lyon, Mich.	G. T.	1891

Howard, G. R., Marshall, Tex.	T. & P.	1891
Henderson, Robt. T., Jackson, Mo.	St. L. I. M. & S.	1892
Himeo, H. C., Needles, Cal.	A. & P.	1892
Harriman, O. B., Hampton, Ia.	I. C.	1892
Hovey, B. L., Rochester, N. Y.	B. R. & P.	1893
Hickman, J. W., Tacoma, Wash.	N. P.	1893
Hughes, W. C., Cleves, O.	C. C. C. & St. L.	1890
Hayes, Noah, Seneca, Kan.	St. J. & G. I.	1891
Haley, Oba, Fredericktown, Mo.	St. L. I. M. & S.	1890
Harvey, Z. T., Council Grove, Kan.	M. P.	1892
Horn, H. Y., Coplay, Pa.	L. V.	1892
Hobson, J. A., Flushing, O.	C. L. & W.	1891
Hall, O. H., Zumbrota, Minn.	C. M. & St. P.	1892
Hewett, S. R., Charles City, Ia.	C. M. & St. P.	1892
Halderman, S. S., Portsmouth, O.	Chief C. P. & V.	1891
Hackett, C. J., Le Mars, Ia.	C. St. P. M. & O.	1891
Harriss, Harvey L., Bellflower, Ill.	I. C.	1893
Hawley, J. E., Burr Oak, Kan.	M. P.	1890
Hyde, J. M., Nelsonville, O.	C. H. V. & T.	1892
Hearne, J. C., San Diego, Cal.	S. C.	1890
Howe, Geo., Columbia, S. C.	South Bound.	1892
Henkel, H. H., Staunton, Va.	C. & O.	1891
Hollester, W. L., Austin, Minn.	C. & G. W.	1891
Haire, Robt. D., Schill City, Mo.	M. K. & T.	1893
Hughes, J. F., Clifton Forge, Va.	C. & O.	1892
Hoy, Wm. S., Wellston, O.	Chief Con. C. H. & D.	1892
Harvie, L. E., Danville, Va.	Chief D. & W.	1892
Hayes, E. S., Eau Claire, Wis.	C. St. P. M. & O.	1892
Haskell, W. A., Alton, Ill.	G. C. C. & St. L.	1892
Henry, W. C., Aurora, Ind.	O. & M.	1890
Hollenbeck, A. G., Willow Springs, Mo.	K. C. Ft. S. & M. Div.	1893
Hollenbeck, B. W., Westville, Ind.	B. & O.	1891
Inge, J. M., Denton, Tex.	M. K. & T.	1891
Inches, Chas., Scribner, Neb.	F. E. & M. V.	1891
Irwin, A. J., 103 S. Main St., Goshen, Ind.	L. S. & M. S.	1893
Ingersoll, L. F., Grand Junction, Col.	D. & R. G.	1891
Isbell, John, Washington, Mo.	M. P.	1893
Iglar, R. P., Ocala, Fla.	J. T. & K. W.	1892
Isham, Albert F., Caldwell, Idaho.	U. P.	1893
Ingram, Wm. T., Murphysboro, Ill.	St. L. A. & T. H.	1892
Iden, B. F., Manassas, Va.	R. & D.	1891
Johnson, A. P., Oakfield, N. Y.	West Shore.	1888
Jones, J. L., Jonesburg, Mo.	Wabash.	1890
Johnson, Geo. K., Grand Rapids, Mich.	Chief G. R. & I.	1890
Justice J. D., Belle Plain, Kan.	M. P.	1890
Johnson, C. M., St. Charles, Mo.	Wabash.	1890
Jenner, Elisha, West Salem, Ill.	P. D. & E.	1890
Jenkins, E. R., Washington, Ia.	C. R. I. & P.	1891
Jauss, John, Grand Island, Neb.	Asst. B. & M.	1891
Jay, Milton, 103 State St., Chicago, Ill.	C. & E. I.	1891
Jacobs, L. D., 503 Union St., Emporia, Kan.	A. T. & S. F.	1891
Jackson, Wm. H., Springville, N. Y.	B. R. & P.	1891
Johnson, Abijah, Montrose, Col.	D. & R. G.	1891
Jonas, A. F., Continental Blk., Omaha, Neb.	F. E. & M. V.	1891
Jackson, W. R., Seymour, Mo.	K. C. Ft. S. & M.	1892
Jeannotte, J. A., Clyde, Kan.	M. P.	1890
Johnson, Geo. W., Savanna, Ill.	C. M. & St. P.	1892
Jones, D. W., Gaylord, Minn.	M. & St. L. Div.	1891
Jackson, Jabez N., Kansas City, Mo.	Wabash.	1891
Jennings, C. A., Salisbury, Mo.	Wabash.	1892
Jenner, A. E., 1913 E. 3d St., Dayton, O.	N. Y. P. & O.	1892
Johnson, Andrew, Hanna, Wyo.	Asst. U. P.	1892
Jackson, John D., Connellsville, Pa.	B. & O.	1892
Johnson, C. H., Austin, Minn.	C. M. & St. P.	1891
Jaques, Wm., Jarvis, Ont., Can.	G. T.	1892
Jones, Thos. H., Jonesboro, Ark.	St. L. S. W.	1892
Johnson, Wm. E., Waverly, N. Y.	N. Y. L. E. & W.	1892
Jones, Geo. N., Burlington, Ia.	C. B. & Q.	1893
Jones, A. B., Wa Keeney, Kan.	Asst. U. P.	1891
Jones, Herbert G., Utica, N. Y.	N. S. Div.	1890
Johnston, Alex., Grandin, Mo.	K. C. F. S. & M.	1893
Jenkins, Geo. W., Kilbourn City, Wis.	C. M. & St. P.	1893
Johnson, Cornelius A., Marcelona, Mich.	G. R. & I.	1893
Jenkins, Wm. S., Sheppton, Pa.	D. S. & S.	1893
Jenne, J. N., St. Albans, Vt.	Chief Cent. Vt.	1893
Kelley, H. R., Gallon, Ohio.	Consulting Erie.	1891
Kaster, J. P., Albuquerque, N. M.	Chief A. & P.	1890
King C. F., Hudson, Wis.	C. St. P. M. & O.	1891
Kelley, Webb J., Gallon, Ohio.	Big Four.	1891

King, A. T., Pueblo, Colo.	D. & R. G.	1893
King, Geo. M., Marysville, Mont.	N. P.	1893
King, W. P., Kansas City, Mo.	Asst. M. P.	1893
Keller, Lester, Ironton, O.	C. & O. Dist.	1893
Knox, M. D., Hillsboro, Tex.	M. K. & T.	1893
Koogler, Marion A., El Dorado, Kan.	M. P.	1893
Kellenberger, E. K., Yates Center, Kan.	M. P.	1893
Kesner, C. C., LeRoy, Kan.	M. P.	1893
Kneeland, C. J., Traverse City, Mich.	C. & W. M. Div.	1893
Kauffman, Jacob S., Blue Island, Ill.	C. R. I. & P.	1893
Knapp, A. R., Leoti, Kan.	M. P.	1893
King, Elmore Y., Richwood, O.	N. Y. P. & O.	1893
Kirschner, P. J., St. Joseph, Mo.	C. R. I. & P.	1893
Kearns, A. J., Loup City, Neb.	B. & M. R.	1893
Kirkpatrick, J. F., London, O.	P. C. C. & St. L.	1893
Kennedy, T. C., Shelbyville, Ind.	P. C. C. & St. L.	1893
Kemper, G. W. H., Muncie, Ind.	L. E. & W.	1891
Kalb, Geo. B., Jeddo, Pa.	L. V.	1891
Keppel, John W., Old Fort, O.	N. Y. C. E. & St. L.	1891
Kirkpatrick, C., Adrian, Mich.	L. S. & M. L.	1892
Kibler, C. B., Corry, Pa.	N. Y. P. & O.	1892
Kimmell, H. S., Somerset, Pa.	B. & O.	1892
Keyes, Ed. D., Winona, Minn.	C. & N. W. Dist.	1892
Kelley, John P., Golden, Col.	U. P.	1892
Kalbaugh, Z. T., Piedmont, W. Va.	B. & O.	1892
Kelly, Thos., South Omaha, Neb.	B. & M.	1893
Kingsbury, J. D., Brown's, Ill.	L. E. & St. L.	1893
Kimmell, Jacob A., Findley, O.	C. C. C. & St. L.	1893
Kinnaman, R. C., Ashland, O.	N. Y. P. & O.	1893
Kuhn, W. A., White Cloud, Mich.	C. & W. M.	1893
Knott, John M., Sioux City, Ia.	S. C. & P.	1893
Kersey, J. H., Stewart, Ia.	C. R. I. & P.	1893
King, J. C. J., Waco, Tex.	M. K. & T.	1892
Knox, A. W., Raleigh, N. C.	Chief Seaboard A. L.	1891
Kilgusmith, I. P., Blairsville, Pa.	Penna.	1893
Kimball, O. B., West Liberty, Ia.	C. R. I. & P.	1891
King, Ogden D., Albermarle, N. C.	R. & D.	1892
Kane, Wm. W., Coulterville, Ill.	St. L. A. & T. H.	1892
Keylor, Howard R., Walla Walla, Wash.	U. P.	1892
King, Clarence, Machias, N. Y.	B. R. & P.	1891
Knight, Samuel S., Fountain Inn, S. C.	G. & L.	1891
Kutnewsky, J. K., Redfield, S. D.	C. & N. W.	1892
Kirby, Geo. L., Goldsboro, N. C.	R. & D.	1891
Livingston, T. P., Plattsmouth, Neb.	B. & M. R.	1893
Lee, E. W., Venetian Bldg., Chicago, Ill.	Penna.	1893
Lewis, E. R., Kansas City, Mo.	Wabash.	1893
Lanpher, Emory, Kansas City, Mo.	K. C. O. & T.	1893
Lynn, Wm. H., Hastings, Neb.	M. P.	1893
Love, Frank S., Belle Plaine, Kan.	M. P.	1893
Linnville, Montgomery, New Castle, Pa.	Penna.	1893
Lightner, S. B., Sabina, O.	B. & O.	1893
Lindsay, Thos., Garnett, Kan.	Santa Fe.	1893
Longshore, W. R., Hazleton, Pa.	L. V.	1891
Lyman, H. H., Fillmore, N. Y.	W. N. Y. & P.	1891
Le Blond, J. B., Sioux Falls, S. D.	C. St. P. M. & O.	1891
Logan, Hugh, The Dalles, Ore.	Asst. U. P.	1891
Lewis, E. C., Penfield, Pa.	A. Y.	1891
Lukins, C. J., Oskaloosa, Ia.	Oculist I. C.	1891
Latham, P. H., Weatherby, Pa.	L. V.	1891
Letcher, Jas. H., Henderson, Ky.	L. & N.	1891
Lee, Edward W., 315 S. 15th St., Omaha, Neb.	B. & M. R.	1892
La Count, D., Wausau, Wis.	M. L. S. & W.	1892
Lornig, S. C., Burr Oak, Ind.	N. Y. C. & St. L.	1892
Lynch, D. W., West Bend, Wis.	C. & N. W.	1892
Lockwood, T. P., Crystal Springs, Miss.	I. C.	1892
Lamb, W. W., 1249 Hanover St., Philadelphia, Pa.	Penna. Dist.	1892
Lacey, Thos. B., Council Bluffs, Ia.	C. & N. W.	1891
Lemen, L. E., 1519 Stout St., Denver, Col.	U. P. Div.	1892
Lawrence, Robert R., Hartford, Mich.	C. & W. M.	1892
Lightner, F. G., Sabina, O.	B. & O.	1893
Leet, N. Y., Scranton, Pa.	Chief D. L. & W.	1893
Lukenmeyer, E. G., Huntingburg, Ind.	L. E. & St. L. C.	1893
Leipziger, H. A., Burlington, Ia.	B. C. R. & N.	1893
Lander, J. W., Afton, Iowa.	C. B. & Q.	1893
Layton, H. R., Leon, Ia.	C. B. & Q.	1893
Laughlin, C. S., Paris, Ill.	Vandalla.	1893
Lord, John P., Omaha, Neb.	Asst. U. P.	1893
Lammers, F. H., Greencastle, Ind.	C. C. C. & St. L.	1892
Latine, R. H., Buchanan, Va.	C. & O.	1892

Lyman, Chas. B., 1517 Stout St., Denver, Colo.	Asst. Div. U. P.	1891
Lee, E. A., Ft. Collins, Colo.	U. P.	1891
Lease, J. I., Chadron, Neb.	F. E. & M. V.	1890
Lutterloth, C. M., Jonesboro, Ark.	K. C. F. S. & M.	1891
Leech, Louis J., West Branch, Ia.	B. C. R. & N.	1891
Landrum, J. B. O., Landrum, S. C.	A. & S.	1891
Loose, D. N., Maquoketa, Ia.	C. M. & St. P.	1893
Lewis, John L., Kensington, Md.	B. & O.	1893
Lane, W. W., Wilmington, N. C.	A. C. L.	1893
Longeway, A. F., Great Falls, Mont.	G. N.	1893
Lewis, Bransford, St. Louis, Mo.	Consulting M. P.	1891
Lusk, Zera J., Warsaw, N. Y.	B. R. O. P.	1891
Linville, David G., Columbia City, Ind.	Wabash.	1898
Leavitt, B. C., 726 14th St., Denver, Colo.	D. & R. G.	1891
Le Fever, Edwin, Sidney, O.	C. H. & D.	1891
Lelsenring, H. G., Wayne, Neb.	C. St. P. M. & O.	1891
Lawrence, W. B., Batesville, Ark.	St. L. I. M. & S.	1888
Lester, F. W., David City, Neb.	Asst. Div. U. P.	1892
Lane, W. H., Miller, S. D.	C. & N. W.	1891
Lawrence, Jas. C. H., Oconto, Wis.	C. M. & St. P.	1892
Leach, Sherman, Mt. Sterling, O.	B. & O.	1891
Linville, D. S., Columbia City, Ind.	Wabash.	1891
Legare, J. Cecil, Donaldsville, La.	T. & P.	1892
Mcad, S. W., Plymouth, Wis.	C. M. & St. P.	1893
McComas, J. Lee, Oakland, Md.	B. & O.	1891
McComas, H. W., Oakland, Md.	B. & O.	1891
McMullen, B. H., Cadillac, Mich.	Asst. Chief T. A. A. & M. M.	1891
Medbeiry, J. N., Webster City, Ia.	Chief C. C. R. R. Co.	1891
McKee, Jas., Raleigh, N. C.	R. & D.	1890
Mussey, R. D., 159 Elm St., Cincinnati, O.	Chief C. H. & D.	1892
McKnight, E. J., Hartford, Conn.	N. Y. & N. E.	1891
Mulhall, J. C., 3609 Tindell Ave., St. Louis, Mo.	Consulting Wabash.	1892
Martin, Z. T., Lathrop, Mo.	H. & St. J. & S. F.	1890
McLean, J., Pullman, Ill.	Chief P. P. C. Co.	1891
McCoy, H. C., Algona, Ia.	C. M. & St. P.	1893
Marcellus, T. M., Sleepy Eye, Minn.	C. & N. W.	1891
McKown, John A., Jonesboro, Ga.	Cent. Ry. of Ga.	1893
McIntosh, Jas., Newberry, S. C.	D. & R.	1891
Miller, D. McL., Oconomowoc, Wis.	C. M. & St. P.	1893
McCurdy, S. L., Denison, O.	P. C. C. & St. L.	
Myers, S. N., Martinsburg, W. Va.	B. & O.	1888
McCollum, E. J., Tiffin, O.	T. W. & O.	1888
Murphy, J. H., St. Paul, Minn.	C. St. P. M. & O.	1888
Murdoch, J. B., Pittsburgh, Pa.	P. C. C. & St. L.	1888
Middleham, H. H., Warrenton, Mo.	Wabash.	1888
McHatton, H., Macon, Ga.	E. T. V. & G. Div.	1888
Mooney, H. C., Laketon, Ind.	C. & A.	1888
Myers, C. W., Clinton, Ia.	C. M. & St. P.	1888
Murray, L. F., Holden, Mo.	M. P.	1889
Moore, Wm. A., Binghampton, N. Y.	D. L. & W.	1889
Mudd, J. R., St. Charles, Mo.	Wabash.	1889
Mullen, Alex. J., Jr., Michigan City, Ind.	M. C. Div.	1889
Mansfield, Alex., Ashland, Neb.	B. & M. R.	1889
Mitchell, J. W., Superior, Neb.	M. V.	1889
Mahon, W. T., Chamois, Mo.	M. P.	1889
Maclin, W. T., DuQuoin, Ill.	I. C.	1889
McCandless, W. L., Pinckneyville, Ill.	St. L. A. & T. H.	1889
McNeill, M. J., Olive Branch, Miss.	K. C. M. & B.	1889
MacLay, A. I., Delavan, Ill.	B. D. & E.	1890
Mitchell, Sollace, Jacksonville, Fla.	Chief J. T. & K. W.	1890
McLean, W. F., Elyria, O.	L. S. & M. S.	1891
Mahon, J. B., Pittston, Pa.	L. V.	1891
Montmollin, J. M., Ashland, Ky.	Chief A. C. & I.	1891
McKnight, H. P., Long Pine, Neb.	F. E. & M. V.	1891
Meyers, Wm. H., Meyersdale, Pa.	B. & O.	1891
Morrow, Wm. B., Walton, N. Y.	N. Y. O. & W.	1891
Mattoon, E. A., Salda, Col.	D. & R. G.	1891
Morgan, Chas. F., Greenville, Mich.	D. L. & W.	1891
Markwith, A. F., Greenville, O.	C. J. & M.	1891
Moody, Geo. W., Huron, S. D.	C. & N. W.	1891
Mosby, Wm. L., Bardwell, Ky.	I. C.	1891
McFarland, A. F., Gallatin, Mo.	C. R. I. & P.	1891
McCallum, Wm., Gladstone, Mich.	M. St. P. & S. S. M.	1891
Morris, E. J., Philadelphia, Pa.	B. & O.	1891
Maynard, H. J., Cheyenne, Wyo.	Asst. U. P.	1891
Mountain, W. S., Confluence, Pa.	B. & O.	1891
Miller, W. H. F., Clifton Forge, Va.	C. & O.	1892
Marks, Solon, Milwaukee, Wis.	Chief C. M. & St. P.	1888
Mendenhall, R. G., La Cygne, Kan.	K. C. F. S. & M.	1889
McKleven, J. A., Chariton, Ia.	C. B. & Q.	1889
Magie, W. H., Duluth, Minn.	St. P. & D.	1889

Miller, Truman W., 211 Opera House Bldg., Chicago, Ill.	Chief C. & G. T.	1892
Monday, W. H., Terrell, Tex.	T. & P.	1891
Mason, John P., Houghton, Mich.	D. S. S. & A.	1891
Mattie, M. B., Sedro, Wash.	S. L. S. & E.	1891
Myers, John D., Huntington, W. Va.	C. & O. Dist.	1892
Miller John A., Rockland, N. Y.	N. Y. O. & W.	1891
McConaughy, Robt., York, Neb.	B. & M. R.	1890
McKinnon, J. A., Selma, Ala.	E. T. V. & G.	1892
Miller, E. J., Marion, S. D.	C. M. & St. P.	1889
Manning, John M., Durham, N. C.	R. & D.	1891
Maller, A. C., De Pere, Wis.	C. M. & St. P.	1891
Mayo, W. J., Rochester, Minn.	C. & N. W.	1891
Meivin, W. J., Duffields, W. Va.	B. & O.	1892
Moore, A. B., Gurdon, Ark.	I. M. & S.	1889
McCoy, P. Y., Evansville, Ind.	L. & N.	1889
Mann, Eugene L., Germania bldg., St. Paul, Minn.	N. P.	1891
Merz, Chas. H., Sandusky, O.	S. & C. S. L.	1889
McClain Wm. A., Olney, Ill.	O. & M.	1892
Mackie, Wm., 107 Wis. St. Milwaukee, Wis.	C. M. & St. P.	1888
Mayer, Edward, Du Quoin, Ill.	I. C.	1891
McIntyre, Chas. W., New Albany, Ind.	O. & M.	1890
Moore, Chas. W., Ely, Minn.	D. & I. R.	1891
Marbourg, E. M., Pueblo, Colo.	Oculist D. & R. G.	1891
Miller, David W., Gilman, Ill.	I. C.	1891
McKay, Wm. T., Arkansas City, Kan.	M. P.	1891
McCleary, T. C., Exeter, Neb.	F. E. & M. V.	1891
McCleary, J. D., Indianola, Ia.	C. R. I. & P.	1891
Mills, Chas. H., Toledo, O.	Chief T. C. C.	1891
McCarty, T. L., Dodge City, Kan.	A. T. & S. F.	1891
McVay, J. D., Lake City, Ia.	C. & N. W. Dist.	1891
Minor, Jas. L., Memphis, Tenn.	Oculist K. C. M. & R.	1891
McOscar, E. J., Ft. Wayne, Ind.	G. R. & I.	1891
Middleton, Wm. D., Davenport, Ia.	Chief C. R. I. & P.	1891
Merchants, M. F., Ellendale, N. D.	C. M. & St. P.	1891
McIlhenny, Robt. A., Conway Springs, Kan.	M. P.	1891
Maurer, A. A., La Crosse, Wis.	C. & N. W.	1891
McDonald, A. J., Bedford, Ind.	E. & R.	1891
McDavitt, Thos. St. Paul, Minn.	Oculist C. M. & St. P.	1891
Merrill, Burton J., Stillwater, Minn.	C. St. P. M. & O.	1891
Murphy, J. B., 36 Washington St., Chicago, Ill.	N. P.	1891
Mills, Theo. D., Middleton, N. Y.	N. Y. O. & W.	1892
Minor, H. A., Macon, Miss.	M. & O.	1892
Manley, Thos. H., New York City, N. Y.	Cent. Park E. & W.	1892
Marsh, W. Q., Sierra Majado, Mex.	Chief Mex. Northern.	1892
Milner, Thos. J., Greenville, Tex.	M. K. & T.	1892
McLean, J. W., Fayette, Ia.	C. M. & St. P.	1892
Moon, Arnold C., Williamsburg, Ia.	C. M. & St. P.	1892
McMintry, Milton, Purcell, Ind. Ter.	A. T. & S. F.	1892
Moll, Louis, Hanover, Kan.	St. J. & G. I.	1892
McKenzie, J. A., El Dorado, Kan.	A. T. & S. F.	1892
Myrick, E. B., Estherville, Ia.	B. C. R. & N.	1892
McArthur, J. A., Berlin, Ont., Can.	G. T. Dist.	1892
Mason, Frank G., 163 State St., Chicago, Ill.	A. T. & S. F.	1892
Mathews, John O., Howe, Tex.	H. & T. C.	1892
Marcy, Alex., Riverton, N. J.	Amboy Div. of Penna.	1892
Maxwell, J. P., Wirt, Ia.	H. & S.	1892
McCray, J. W., Marble Rock, Ia.	B. C. R. & N.	1892
Moore, Geo. R., Oxford Junction, Ia.	C. M. & St. P.	1892
Martin, J. C., Findley, O.	B. & O.	1892
Martyn, David T., Columbus, Neb.	U. P.	1892
Marsh, F. L., Mt. Pleasant, Pa.	Penna.	1892
Moore, S. D., Van Alstyne, Tex.	H. & T. C.	1892
Murphy, F. T., Brinkley, Ark.	Cotton Belt.	1893
Morse, A. H., Pittsville, Wis.	C. M. & St. P.	1893
Murdock, J. Moorhead, Dixmont, Pa.	P. C. C. & St. L.	1893
Mears, D. W., Audenried, Pa.	L. V.	1893
Musselman, J. T., Paris, Ill.	Big Four.	1893
McInnes, R. W., Belvidere, Ill.	C. & N. W.	1893
Murrell, D. G., Paducah, Ky.	N. N. & M. V. Co.	1893
McKeller, A. R., Greenspring, O.	N. Y. C. & St. L.	1893
McClung, John C., Leipsic, O.	N. Y. C. & St. L.	1893
Macrae, Donald, Council Bluffs, Ia.	C. M. & St. P.	1893
Morton, Wm. M., Iowa Falls, Ia.	B. C. R. & N. Div.	1893
McGannon, E. A., Brockville, Ont., Can.	G. T.	1893
Martin, J. W., Colby, Kan.	U. P.	1893
Morgan, H. W., Clay Center, Kan.	Asst. U. P.	1893

McDonald, J. L., Atchison, Neb.	F. E. & M. V.	1893
Morris, B., Lawrence, Kan.	A. T. & S. F.	1893
McDonald, R. C., Freemont, Neb.	U. P.	1893
McGrew, A. G., Geneva, Neb.	F. E. & M. V.	1893
McGavern, H. S., Stromsburg, Neb.	U. P.	1893
Millam, B. J., Macon, Mo.	C. B. & Q.	1893
McNutt, H. E., Aberdeen, S. D.	C. & N. W.	1892
Meriwether, Alfred P., Jerseyville, Ill.	St. L. C. & St. P.	1893
Mudge, S. J., Olean, N. Y.	W. N. Y. & P.	1893
Murray, T. J., Butte City, Mont.	Chief Mont. Union.	1889
Nugent, W. R., Oskaloosa, Ia.	Chief I. C.	1888
Newcomer, M. V. B., Tipton, Ind.	L. E. & W.	1889
Nolan, E. C., Mt. Pulaski, Ill.	P. D. & E.	1890
Nye, W. W., Hiawatha, Kan.	M. P.	1890
Nash, G. A., Marysville, Mo.	O. & St. L.	1891
Nihiser, Winton M., Keedysville, Md.	B. & O.	1891
Newcomb, W. K., Fisher, Ill.	I. C.	1891
Norin, F. L., Ada, Minn.	N. P.	1891
Nance, W. H., Gundison, Miss.	L. N. O. & T.	1891
Neal, B. E., New Harmony, Ind.	P. D. & E.	1893
Neely, J. J., Jr., Bolivar, Tenn.	I. C.	1893
Newton, Richard C., Mount Clair, N. J.	Erie.	1893
Noland, Jas. F., North Judson, Ind.	P. C. C. & St. L.	1892
Northrop, G. J., Marquette, Mich.	Chief D. S. S. & A.	1888
Neisley, C. M., Stockton, Pa.	L. V.	1892
Nutt, Geo. D., Williamsport, Pa.	Ex-Surg. F. B.	1891
Nicholson, A. W., Newberry, Mich.	D. S. S. & A.	1891
North, Samuel L., Clayton, N. M.	Asst. U. P.	1892
Nelson, Hugh T., Charlottesville, Va.	C. & O.	1891
Nickell, G. M., Millsboro Depot, Va.	C. & O.	1891
Oven, T. P., Brookfield, Mo.	H. & St. J.	1889
O'Connell, J. M., Ponca, Neb.	C. St. P. M. & O.	1891
O'Connor, J. W., 619 Equitable bldg., Denver, Colo.	Chief D. & R. G.	1889
Owens, John E., 1806 Mich. Ave., Chicago, Ill.	Chief C. & N. W.	1889
O'Brien, D. S., Beloit, Kan.	U. P.	1892
Osborne, H. B., Kalamazoo, Mich.	L. S. & M. S.	1888
Olds, W. H., Sprague, Wash.	N. P.	1891
Outton, W. B., St. Louis, Mo.	Chief M. P.	1888
O'Connell, R. S., Cato, Wis.	M. L. S. & W.	1889
Overstreet, W. C., Sedalia, Mo.	M. P.	1889
O'Brien, M. W., Alexandria, Va.	R. & D.	1891
Owens, Cleon C., Maysville, Ky.	C. & O.	1891
Oettiker, Jas., Plattsville, Wis.	C. & N. W.	1891
Owings, John H., Deer Lodge, Mont.	M. W.	1891
Oldham, Jas. E., Wichita, Kan.	Consulting, A. T. & S. F.	1891
O'Daniel, W., Atlanta, Ga.	E. T. V. & G. Co.	1892
O'Brien, W. D., Pittsburgh, Pa.	B. & O.	1892
Overholser, M. P., Harrisonville, Mo.	M. P.	1893
Powell, W. M., Albany, Tex.	Tex. Cent.	1892
Pettijohn, N. J., Kansas City, Mo.	Chief K. C. Ft. S. & M.	1888
Perezde, Yarto R., Guanajuato, Acarbaro, Mex.	Mex. Nat.	1892
Pitman, J., Kirkwood, Mo.	M. P.	1889
Phlippen, S. S. C., Owosso, Mich.	M. C.	1891
Pease, W. C., Cumberland, Wis.	Special C. St. P. M. & O. 1/2 1/2 1/2	1891
Pritchard, A. L., Buchtel, O.	C. H. V. & T.	1892
Peck, R. C., Hinton, W. Va.	C. & O. Dist.	1891
Pattison, L., Oelwein, Ia.	B. C. R. & N.	1888
Pachard, N. I., Sturgis, Mich.	L. S. & M. S.	1888
Pace, Henry L., Tulare, Cal.	S. P.	1892
Pourquie, Louis V., Torreón Coahuila, Mex.	I. M. Div.	1892
Peebles, G. H., Lincoln, Neb.	U. P.	1888
Powell, D. T., Thayer, Mo.	K. C. F. S. & M.	1888
Pogue, Joseph, Edwardsville, Ill.	Wabash.	1889
Powell, C. B., Albia, Ia.	C. B. & Q.	1888
Pritchard, J. F., Manitowoc, Wis.	Chief M. L. S. & W.	1889
Phelps, Chas. H., St. Mary's, O.	L. E. & W.	1890
Philler, Hugo, Waukesha, Wis.	C. M. & St. P.	1890
Porter, Miles F., Ft. Wayne, Ind.	Wabash.	1890
Priest, W. R., Concordia, Kan.	M. P.	1890
Pearman, J. T., Champaign, Ill.	I. C.	1890
Peck, C. R., Scranton, Pa.	N. Y. O. & W.	1891
Peck, F. H., Clinton, N. Y.	N. Y. O. & W.	1891
Peck, S. P., Hinton, W. Va.	C. & O. Dist.	1891
Phillips, Ellis, New Haven, Pa.	P. & L. E.	1891
Patton, Wm. R., Charleston, Ill.	T. St. L. & K. C.	1891
Phillips, N. D., Gainesville, Fla.	S. F. & W.	1891
Payne, Robert Lee, Jr., Lexington, N. C.	R. & D.	1891

Page, J. F., Mystic, Ia.	C. M. & St. P.	1891
Philpott, C. H., Ottumwa, Ia.	C. B. & Q.	1891
Pilkington, G. W., Garnett, Kan.	M. P.	1891
Parker, C. B., 564 Euclid Ave., Cleveland, O.	L. S. & M. S.	1891
Penhall, Fletcher W., Birch Cooley, Minn.	M. & St. L.	1891
Palne, Henry E., Dixon, Ill.	C. & N. W. Dist.	1891
Patton, Jas. H., Trenton, Mo.	C. R. L. & P.	1892
Pettit, W. B., New Canton, Va.	C. & O.	1892
Parke, W. T., Listowel, Ont., Can.	G. T. Dist.	1892
Plum, Henry A., Hawley, Pa.	N. Y. L. E. & W.	1892
Philpott, John W., Ft. Madison, Ia.	Chief C. F. M. & D. M.	1892
Perkins, Frederick, Manchester, N. H.	C. & M.	1892
Potter, J. H., Buffalo, N. Y.	G. T.	1892
Patchin, F. J., Nelson, Neb.	C. R. I. & P.	1892
Palmer, Henry, Janesville, Wis.	C. & N. W. Dist.	1892
Pease, Hiram L., 7530 Greenwood, Ave., Chicago, Ill.	N. Y. C. & St. L.	1892
Ponder, W. P., Forsyth, Ga.	Cent. Ry. of Ga.	1892
Pugh, Thos. J., Hearne, Tex.	I. & G. N.	1892
Punton, John, 9th St. and Grand Ave., Kansas City, Mo.	K. C. F. S. & M.	1892
Pinney, C. H., Council Bluffs, Ia.	C. R. I. & P.	1893
Patton, F. W., Mt. Vernon, Ill.	L. & N. J. S.	1893
Pearse, S. H., Mt. Vernon, Ind.	E. & T. H.	1893
Pope, Thos. A., Cameron, Tex.	G. C. & S. F.	1893
Palmer, W. H., Janesville, Wis.	C. & N. W.	1893
Plumb, J. N., Fairmount, Neb.	St. J. & G. I.	1893
Peabody, John D., 1714 Douglas St., Omaha, Neb.	M. P.	1893
Pelton, D. R., 1283 Lane St., Topeka, Kan.	A. T. & S. F.	1893
Pettyjohn, J. W., Hoyt, Kan.	C. R. I. P.	1893
Peters, A. B., Mankato, Kan.	C. R. I. P.	1893
Peabody, Jas. H., 1909 Capitol Ave., Omaha, Neb.	Consulting, U. P.	1893
Pritchett, G. L., Fairbury, Neb.	C. R. I. & P.	1891
Putman, B. B., Bucklin, Mo.	A. T. & S. F.	1890
Powell, W. S., Defiance, O.	Wabash.	1891
Parks, S. H., Longton, Kan.	A. T. & S. F.	1893
Parker, E. H., Eau Clair, Wis.	W. C.	1891
Perry, Benj. J., 309 S Mill St., Aspen, Colo.	Asst. C. M.	1892
Paddock, J. A., Deadwood, S. D.	Asst. B. & M. R.	1891
Parker, Joseph, Colfax, Ind.	C. C. C. & St. L.	1890
Peckstein, J. W., Wyaconda, Mo.	A. T. & S. F.	1892
Petty, J. W., Wells, Nev.	S. P.	1892
Portmann, Wm. C., Jackson, Minn.	C. M. & St. P.	1893
Preston, G. H., Kane, Pa.	P. & E. of Pa. Ry.	1892
Potter, I. L., Ackley, Ia.	I. C.	1891
Patterson, P. D., Charlotte, Mich.	C. & G. T.	1892
Quigley, R. F., Vermillion, Ohio.	L. S. & M. L.	1893
Quinn, Allen L., Wilmington, O.	B. & O.	1890
Quinn, J. A., St. Paul, Minn.	M. & St. P. & S. S. M.	1892
Robinson, C. E., Clarksville, Ark.	L. R. & Ft. S.	1890
Ray, C. A., Winifrede, W. Va.	Chief Winifrede.	1892
Rook, Chas. W., 1103 Maine, Quincy, Ill.	Ex-Surg. C. B. & Q.	1889
Rathbun, Jas. P., Faulkton, S. D.	C. & N. W.	1891
Rogers, N. L., Wickliffe, Ky.	M. & O.	1893
Redus, W. D., Port Gibson, Miss.	Y. & M. V.	1891
Rice, S. M., Terre Haute, Ind.	Chief Vandalla Line	1889
Rogers, W. R., Memphis, Tenn.	Chief K. C. M. & B.	1888
Reed, R. Harvey, Columbus, O.	Con. Surg. B. & O., "Big Four."	1888
Russell, L. E., Springfield, O.	Chief O. S.	1888
Richardson, N. S., Macon, Mo.	Wabash.	1888
Richey, J. C., Mt. Sterling, Ill.	Wabash.	1888
Riddell, S. S., Chippewa Falls, Wis.	C. St. P. M. & O.	1891
Rice, John T., Attica, Ind.	W. St. L. & P.	1888
Rhu, Auguste, Marion, O.	C. C. C. & St. L.	1888
Redden, R. J., Sulligent, Ala.	K. C. M. & B.	1889
Robinson, S. E., West Union, Ia.	C. M. & St. P.	1880
Robert, Jas. J., Hillsboro, Tex.	St. L. & S. W.	1889
Root, E. F., Salt Lake City, Utah.	Ex. Surg. F. E. & M. V.	1889
Root, A. D., Crete, Neb.	M. P.	1880
Ragsdale, J. E., Gibson City, Ill.	Wabash.	1889
Rambo, J. H., Glenwood, Mo.	Wabash.	1890
Redmon, S. H., Tipton, Mo.	M. P.	1890
Robinson, E. M., Bessemer, Ala.	L. & N.	1890
Reynolds, Lawrence, Horton, Kan.	C. R. I. & P.	1890
Reber, W. W., Lehigh, Pa.	L. V.	1890
Richey, J. A., Oil City, Pa.	N. Y. P. & O.	1891
Ross, Geo., Richmond, Va.	Chief R. & D.	1891
Rood, C. A., Reedsburg, Wis.	C. & N. W.	1891

Rosborough, J. L., Senatobia, Miss.	I. C.	1891
Rowe, Wm. H., St. James, Minn.	C. St. P. M. & O.	1891
Reynolds, O. C., Seward, Neb.	B. & M. R.	1891
Ristine, H. G., Ft. Dodge, Ia.	I. C.	1891
Read, Edward W., Mandan, N. D.	N. P.	1891
Richardson, W. D., Centralia, Ill.	J. S. E. Line.	1891
Reeve, J. T., Appleton, Wis.	C. & N. W.	1891
Richards, W. M., Joliet, Ill.	C. R. I. & P.	1891
Rush, M. A., Goodland, Kan.	C. R. I. & P.	1891
Russell, Clayton W., Springfield, O.	Asst. Big Four.	1891
Rothwell, John H., Liberty, Mo.	C. M. & St. P.	1892
Robinson, Thos. G., Amsterdam, Mo.	K. C. P. & G.	1892
Rose, Walter A., Rochester, Pa.	C. P. Div. Penna.	1892
Roberts, W. O., 1041 2d St., Louisville, Ky.	L. & N.	1892
Rewalt, L. L., Fulda, Minn.	C. M. & St. P.	1892
Reger, J. F., Littleton, W. Va.	B. & O.	1892
Riordan, Bruce L., 384 King St., Toronto, Can.	G. T.	1892
Rogers, F. W., Hartford, Wis.	C. M. & St. P.	1892
Ray, A. R., Fairfield, Neb.	St. J. & G. I.	1892
Rownd, F. L., Dighton, Kan.	A. T. & S. F.	1893
Rogers, W. J., Coleman, Ga.	Cent. Ry. of Ga.	1893
Rhea, W. M., Larned, Kan.	A. T. & S. F.	1893
Russell, D. G., Spokane, Wash.	Asst. N. P.	1893
Runcle, J. W., Ft. Branch, Ind.	E. & T. H.	1893
Ross, J. H., Kokomo, Ind.	T. St. L. & K. C.	1893
Rich, T. C., Williamsport, Pa.	P. & N. C.	1893
Rice, H. N., Fairmount, Minn.	C. M. & St. P.	1893
Robinson, Jabez P., McCormick, S. C.	Cent. Ry. of Ga.	1891
Reynolds, E. M., Centerville, Ia.	K. & W.	1888
Russell, John E., Mt. Vernon, O.	C. A. & C.	1889
Ross, J. Frank, Clarion, Pa.	P. & W.	1891
Richings, Henry, Rockford, Ill.	C. & N. W.	1891
Robbins, S. D., Vicksburg, Miss.	Chief V. & M.	1889
Rushing, S. H., Alexandria, La.	T. & P. Div.	1892
Rhodes, J. W., Tekoa, Wash.	U. P.	1891
Riddell, Wm. C., Elkhorn, Mont.	N. P.	1891
Robertson, J. F., Caldwell, Kan.	C. R. I. & P.	1893
Rose, Henry G. C., Milbank, S. D.	C. M. & St. P.	1892
Robinson, De L. W., Pierre, S. D.	C. & N. W.	1893
Rainey, Geo. L., Salem, Ill.	O. & M.	1889
Robinson, J. F., Manchester, N. H.	O. & M.	1892
Rader, W. H., Durango, Colo.	D. & R. G.	1891
Rounsevell, A. P., Larimore, N. D.	G. N.	1891
Rucher, G. R., Eufaula, I. T.	M. K. & T.	1891
Rheinfrank, J. H., Perrysburg, O.	C. H. & D. Div.	1891
Riggs, Samuel M., Muscotah, Kan.	M. P.	1891
Rixey, Alfred S., Culpepper, Va.	R. & D.	1891
Reeve, Jas. S., Appleton, Wis.	C. & N. W.	1892
Smith, Arthur H., Avon, N. Y.	N. Y. L. E. & W.	1891
Stout, S. H., 499 Live Oak, Dallas, Tex.	T. & P.	1891
Saner, W. F., Hope, Ark.	St. L. I. M. & S.	1891
Saunders, H. J., Kingstown, Ont., Can.	G. T. Dist.	1891
Sperry, W. P., Phillips, Wis.	N. P.	1892
Saunders B., Ft. Worth, Tex.	T. & P.	1891
Spilman, S. A., Ottumwa, Ia.	Wabash.	1890
Shirley, I. A., Winchester, Ky.	C. & O.	1892
Swartwout, H. B., Port Jervis, N. Y.	N. Y. L. E. & W.	1892
Stephens, F. M., Sayre, Pa.	L. V.	1891
Sabine, Andrew, Garden City, Kan.	A. T. & S. F.	1892
Stee, C. S., Wallace, Idaho.	U. P.	1892
Schug, F. J., Tacoma, Wash.	U. P.	1892
Shine, M. L., Winthrop, Ia.	I. C.	1891
Standly, Z. T., Laclede, Mo.	C. B. & K. C.	1891
Stout, Abraham, Bethlehem, Pa.	L. V.	1892
Strickland, D. H., Erie, Pa.	E. & P.	1890
Scott, Clinton H., Como, Colo.	U. P.	1893
Shuttee, H. C., West Plains, Mo.	K. C. Ft. S. & M.	1888
Spencer, C. E., Fort Gratiot, Mich.	G. T.	1891
Strickler, O. C., New Ulm, Minn.	C. & N. W.	1891
Smith, C. L., Aurora, Ill.	C. B. & Q. Div.	1892
Scobey, W. E., Kankakee, Ill.	Chief I. L. I.	1892
Snook, J. M., Kalamazoo, Mich.	M. C. Div.	1891
Snow, T. N., Baker City, Ore.	Asst. U. P.	1892
Strickney, V. H., Dickinson, N. D.	N. P.	1892
Shellito, Amos G., Independence, Ia.	B. C. R. & N.	1892
Stinson, C. H., Newark, O.	B. & O.	1891
Schmidt, F. W., Riverdale, Ill.	I. C.	1893
Stewart, Darwin A., Winona, Minn.	C. M. & St. P.	1891
Sutherland, H. H., Herington, Kan.	C. R. I. & P.	1891
Sims, W. A., Paragould, Ark.	St. L. & I. M.	1890
Charles, W. T., Sparta, Wis.	C. M. & St. P.	1891

Steiger, Emil, Prairie du Chien, Wis.	C. M. & St. P.	1892
Sydnor, C. W., Strasburg, Va.	R. & D.	1891
Slaughter, R. M., Belton, Mo.	K. C. O. & S.	1891
Sanders, J. W., KallsPELL, Mont.	Ex-Surg. B. & M.	1888
Smith, E. J., Port Washington, Wis.	M. L. S. & W.	1889
Stine, C. H., 1916 Preston St., Louisville, Ky.	M. P.	1891
Smith, J. P., Canton, S. D.	C. M. & St. P.	1892
Shoffner, J. H., Water Valley, Miss.	I. C.	1891
Spitler, S. W., 111 E. Harvey Ave., Wellington, Kan.	A. T. & S. F.	1893
Squire, L. A., Paynette, Wis.	C. M. & St. P.	1893
Shelly, S. T., Mulvane, Kan.	A. T. & S. F.	1892
Smith, Jacob D., Shelbina, Mo.	H. & St. J.	1891
Stephens, I. C., Akron, Colo.	B. & M.	1893
Smolley, John G., Connersville, Ind.	Ft. W. L. & C.	1893
Spence, I. N. B., Social Circle, Ga.	Ga. Ry.	1893
Scott, Stanhope M., Terra Alta, W. Va.	B. & O.	1891
Sawyers, J. L., Centerville, Ia.	C. R. I. & P.	1893
Slaton, A. J., Leitchfield, Ky.	N. N. & M. V.	1893
Strickler, Frank P., Elizabethtown, Ky.	N. N. & M. V.	1893
Sibley, Chas. W., Fairfield, Ill.	O. & M.	1890
Shultz, J. B., Logansport, Ind.	P. C. & St. L.	1888
Stillings, F. A., Concord, N. H.	Chief C. & M.	1888
Scott, Wm., Kokomo, Ind.	L. E. & W.	1888
Stemen, C. B., Ft. Wayne, Ind.	Wabash.	1888
Stovall, A. M., Jasper, Ala.	K. C. M. & B.	1889
Sawtell, J. E., Gypsum, Kan.	M. P.	1889
Scott, John T., Holton, Kan.	U. P.	1889
Suggett, W. Le Grand, Flora, Ill.	O. & M.	1889
Sawhill, W. F., Concordia, Kan.	M. P.	1889
Stocker, S. M., Duluth, Minn.	D. S. S. & A.	1889
Smith, C. A., Tyler, Tex.	Chief St. L. S. W.	1889
Stuart, D. F., Houston, Tex.	Chief H. & T. C.	1889
Stewart, W. W., Clarksdale, Miss.	Y. & M. V.	1890
Slager, J. L., Paulding, O.	C. J. & M.	1890
Scoles, J. P., Galena, Kan.	K. C. F. S. & M.	1890
Shidler, G. W., Cincinnati, O.	Ex. Surgeon B. & M. R.	1890
Shoptaugh, S. H., Princeton, Ind.	E. & T. H.	1890
Sisler, L. E., Clinton, O.	C. A. & E.	1890
Smolt, Chas. F., Nickerson, Kan.	A. T. & S. F.	1890
Stanton, T. P., Chariton, Ia.	C. B. & Q.	1890
Stockwell, C. M., Port Huron, Mich.	C. & G. T.	1891
Scott, J. W., St. Charles, Minn.	C. & N. W.	1891
Sanford, Silas, Palmyra, Mo.	H. & St. J.	1891
Shields, S. S., Carbondale, Pa.	N. L. E. & W.	1891
Smith, S. S., Emporium, Pa.	W. N. Y. & P.	1891
Senn, N., 532 Dearborn Ave., Chicago, Ill.	C. K. C. & St. P.	1891
Smith, Chas. F., Kankakee, Ill.	I. C.	1891
Smart, Edward N., Humphrey, Neb.	F. E. & M. V.	1891
Smith, Norman, P., Paris, Ill.	T. H. & P.	1891
Smith, Irving W., Charles City, Ia.	I. C.	1891
Stinson, J. B., Sherman, Tex.	T. & P.	1891
Stoddard, Luke F., Ramsey, Ill.	T. St. L. & K. C.	1891
Seymour, F. E., Ft. Dodge, Ia.	M. & St. L.	1891
Sawbridge, Edward, Stephenson, Mich.	C. & N. W.	1891
Stuart, J. R., Houston, Tex.	Asst. H. & T. C.	1891
Sanderson, Ira L., Sturgis, S. D.	B. H. & Ft. P.	1891
Sulter, F. C., La Crosse, Wis.	C. B. & N.	1891
Shelton, J. A., Grayville, Ill.	P. D. & E.	1891
Shuey, W. A., Piedmont, W. Va.	B. & O.	1891
Summers, J. E., Jr., 208 S. 15th St., Omaha, Neb.	C. R. I. & P.	1891
Shields, Jas. M., Seymour, Ind.	E. & R.	1891
Spaulding, Geo. A., Avoca, Ia.	C. R. I. & P.	1891
Sanford, W. B., Corinth, Miss.	M. & C.	1892
Sprowls, J. N., Claysville, Pa.	B. & O.	1892
Scott, C. M., Payette, Idaho.	Asst. U. P. Div.	1892
Schenek, J. S., Mt. Carmel, Ill.	C. C. C. & St. L.	1892
Sheridan, J. C., Johnstown, Pa.	B. & O.	1892
Speicher, Asa F., Elk Lick, Pa.	B. & O.	1892
Stephenson, Jas., Iroquois, Ont., Can.	G. T. Dist.	1892
Schaufelberger, F. J., Hastings, Neb.	St. J. & G. I.	1892
Smith, A. M., Beaver Springs, Pa.	Penna.	1892
Smith, W., Delphi, Ind.	L. N. A. & C.	1892
Schureman, I. C., Tom's River, N. J.	Penna.	1892
Shetler, S. J., Navarre, O.	C. C. & S.	1892
Smith, R. W., Bruce, Seaforth, Ont., Can.	G. T.	1892
Smith, Fred J., Alton, Ia.	C. & N. W.	1892
Scott, A. C., Temple, Tex.	Chief G. C. & S. F.	1892
Stealy, J. H., Freeport, Ill.	C. M. & St. P.	1892
Starkey, Herbert A., Harvey, Ill.	I. C.	1892
Strong, J. T., Plainfield, Ind.	Vandalla.	1892
Smith, C. S., Elroy, Wis.	C. & N. W. Dist.	1892

Smith, Geo. S., Liberal, Kan.	C. R. I. & P.	1892
Swift, Elisha P., Florence, Wis.	C. & N. W.	1892
Smith, Southwood, Garnett, S. C.	South Bound.	1892
Shinn, Wm. R., Chenoa, Ill.	T. P. & W.	1892
Shrader, John C., Iowa City, Ia.	R. G. R. & N.	1892
Smith, W. P., Gothenburg, Neb.	U. P.	1892
Smith, Leander B., Fremont, Neb.	U. P.	1892
Skiff, P. A., Frankfort, N. Y.	W. S.	1892
Stevens, Henry L., Laramie, Wyo.	Asst. U. P. Div.	1892
Switzer, E. R., Salina, Kan.	M. P.	1893
Schott, Geo., Sioux City, Ia.	C. M. & St. P.	1893
Sherman, J. A., Cherokee, Ia.	I. C. Dist.	1893
Sampson, G. W., Upper Sandusky, O.	P. F. W. & C. Div.	1893
Shirrad, A. C., Oakwood, O.	N. Y. C. & St. L.	1893
Sheley, O. C., Independence, Mo.	K. C. & I. A. L.	1893
Salter, P. H., Norfolk, Neb.	F. R. & M. V.	1893
Slabangh, Warren H., So. Omaha, Neb.	C. R. I. & P.	1893
Sadler, S., Alma, Neb.	St. J. & G. I.	1893
Shinault, Chas. R., Helena, Ark.	Y. & M. V.	1893
Suggett, Orril Le Grand, Flora, Ill.	O. & M.	1893
Sheldon, Silas E., Topeka, Kan.	U. P.	1893
Smith, Lester C., Hurley, Wis.	N. P.	1893
Stiver, R. J., Lena, Ill.	I. C.	1893
Straight, A. M., Bradford, Pa.	B. R. & P.	1893
Shipps, W. H., Bordentown, N. J.	Penna.	1892
Torbert, John S., Driftwood, Pa.	P. & E.	1892
Titus, A., Portsmouth, O.	C. & O. Div.	1892
Thompson, C. Y., Beaumont, Tex.	S. P.	1891
Tomlinson, O. R., Tate Springs, Tenn.	M. & C. G.	1891
Towler, S. S., Marienville, Pa.	P. & W.	1891
Truax, W. E., Breckenridge, Minn.	C. & N. W.	1891
Terrell, E. A., Frederick's Hall, Va.	C. & O.	1892
Thompson, Wm. A., Olney, Ill.	P. D. & E.	1890
Tandy, Thos. S., Kinderhook, Ill.	Wabash.	1893
Thayer, A. H., Grafton, W. Va.	B. & O.	1892
Tye, R. P., Claredon, Tex.	F. W. & D. C. Div.	1891
Thornton, T. F., Sturgis, Mich.	G. R. & I. Div.	1891
Thompson, G. W., Winamac, Ind.	Pan. Handle.	1893
Terry, N. F., Lyons, Kan.	M. P.	1890
Thomas, O. F., Chillicothe, Ill.	A. T. & S. F.	1893
Turner, Henry, Milbrook, Ont., Can.	G. T.	1893
Thorburn, Jas., Drawer 2501, Toronto, Can.	Consulting G. T.	1892
Thornton, John H., Lansing, Ia.	C. M. & St. P.	1892
Thorn, Sam'l S., Toledo, O.	Chief T. St. L. & K. C.	1893
Thompson, G. T., Golden City, Mo.	K. C. F. S. & M.	1893
Tidd, C. H., Geneva, Ia.	C. I.	1893
Tanner, H. B., Kaukauna, Wis.	M. L. S. & W.	1893
Tenney, A. P., Kansas City, Kan.	M. P.	1893
Talley, H. A., Wentzville, Mo.	Wabash.	1893
Toombs, R. S., Greenville, Miss.	R. & D.	1893
Turner, E. M., Norton, Kan.	Ex. Asst. B. & M. R.	1893
Thompson, Benj., Tama, Ia.	C. & N. W.	1891
Thompson, A. A., Waxahachie, Tex.	M. K. & T.	1891
Tiffin, Clayton, Hamilton, Mo.	H. & St. J.	1891
Tweedle, J. B., Weatherly, Pa.	L. V.	1891
Thayer, H. W., Corry, Pa.	W. N. Y. & P.	1891
Turner, E. F., Leland, Miss.	Y. & M. V.	1891
Thompson, L. A., Traverse City, Mich.	G. R. & I.	1891
Taylor, H. M., Richmond, Va.	C. & O.	1891
Tuller, Willis M., Bowling Green, O.	D. & M.	1891
Tarkington, Joseph, Washington, D. C.	B. & O.	1891
Trowbridge, J. B., Hayward, Wis.	C. St. P. M. & O.	1891
Treacy, Wm., Helena, Mont.	N. P.	1891
Truehart, P. P., Sterling, Kan.	M. P.	1891
Tope, J. W., Oak Park, Ill.	C. & N. W.	1891
Thornton, Van B., Hamstead, Tex.	H. & T. C.	1891
Travers, E. R., Amboy, Ill.	I. C. Dist.	1891
Thrush, Thos. B., Kansas City, Mo.	K. C. C. & S.	1891
Thompson, Benj., Landenburg, Pa.	Phila. Div. B. & O.	1892
Talley, A. N., Columbia, S. C.	Chief C. & N. L.	1892
Tate, H. W., Bolivar, Tenn.	I. C.	1892
Taylor, Wilson, Utica, Kan.	M. P.	1892
Tulles, J. W., Cheyenne Wells, Col.	U. P.	1892
Thomas, Frank W., Marion, O.	C. & E.	1892
Temple, J. W., Eldon, Mo.	M. P.	1893
Taylor, W. J., Pipestone, Minn.	C. M. & St. P.	1893
Tidball, J., Grafton, Ill.	St. L. C. & St. P.	1893
Tinder, J. T., Parsons, Kan.	K. C. F. S. & M.	1893
Trimmer, S. W., White Haven, Pa.	L. V.	1891
Taylor, B. W., Columbia, S. C.	R. & D.	1892
Troupe, A. W., Pine Bluff, Ark.	St. L. S. W.	1893
Underwood, M., Eldora, Ia.	I. C.	1893

Umstad, H. U., Phoenixville, Pa.	Penna.	1892
Ulrich, W. B., Chester, Pa.	Chief P. W. & B.	1891
Vankirk, W. F., Grafton, W. Va.	B. & O.	1891
Van Meter, A., Lamar, Mo.	K. C. F. S. & M.	1888
Vincent, Fred W., Pendleton, Ore.	U. P.	1892
Vest, Wm. E., Montezuma, Ia.	I. C.	1891
Vance, N. N., Bement, Ill.	W. St. L. & P.	1888
Vincent, E. B., Sunman, Ind.	C. C. C. & St. L.	1888
Vanden, Geo., Seward, Neb.	Ex-Surg. C. & O.	1891
Vall, A. M., Rock Rapids, Ia.	I. C.	1891
Vander, Veen A., Grand Haven, Mich.	D. G. H. & M.	1891
Vadakin, J. H., Bethany, Ill.	P. D. & E.	1891
Vance, W. K., Bristol, Tenn.	E. T. V. & G.	1892
Vorhes, B. C., Lee, O.	T. & O. C.	1892
VanKirk, B. H., West Newton, Pa.	B. & O.	1892
Venard, J. N., Ness City, Kan.	A. T. & S. F.	1892
Van Duyn, John, Syracuse, N. Y.	West Shore.	1893
Valentine, J. Frank, 150 Noble St., Brooklyn, N. Y.	Long Island.	1891
Wright, A. L., Carroll, Ia.	C. & N. W. Div.	1888
Weaver, J. M., Dayton, O.	C. C. C. & St. L.	1888
Ward, W. A., Conneaut, O.	N. Y. C. & St. L.	1888
Wilson, J. H., Plymouth, Ind.	P. F. W. & O.	1888
Wallis, R. S., Arkadelphia, Ark.	St. L. I. M. & S.	1889
Willson, Geo. C., Nevada, Mo.	M. P.	1889
Witherington, W. T., Paragould, Ark.	St. L. I. M. & S.	1889
Wilson, B. F., Slater, Mo.	C. & A. Div.	1889
Willis, L. E., New Port, Ark.	St. L. I. M. & S.	1889
White, E. E., Morton, Kan.	C. R. I. & P.	1889
White, Clarence H., Reed City, Mich.	G. R. & I. Div.	1890
Williams, A. O., Ottumwa, Ia.	C. R. I. & P.	1890
Wright, John, Sardis, Miss.	I. C.	1891
Weaver, W. G., Wilkesbarre, Pa.	L. V.	1891
Williams, H. J., Macon, Ga.	Cent. Ry. of Ga.	1891
Warner, C. F., Mankato, Minn.	C. & N. W.	1891
Williams, W. T., Mt. Carmel, Pa.	Penna.	1891
Webster, Wm. S., Liberty, N. Y.	N. Y. O. & W.	1891
Watson, R. B., Lock Haven, Pa.	P. & E.	1891
West, T. H., Keyser, W. Va.	B. & O.	1890
Wilson, C. G., St. Mary's, Pa.	P. & E.	1891
Wheeler, H. M., Grand Forks, N. D.	G. N.	1891
Wagner, S. V., Bremond, Tex.	H. & T. C.	1891
Wilson, S. B. S., Olatha, Kan.	K. C. F. S. & M.	1891
Wallace, R. S., East Brady, Pa.	A. V.	1891
Woods, G. B., West Alexander, Pa.	B. & O.	1891
Williams, Walter L., Ridgway, Pa.	P. & E.	1891
Wilson, John G., Perth Amboy, N. J.	L. V.	1891
Wood, I. C., Logan, Ia.	C. & N. W.	1891
Watt, W. Neal, Burton, Tex.	H. & T. C.	1891
Waite, Ira W., Holyoke, Col.	Asst. B. & M. R.	1891
Warne, J. C., Cambridge, O.	Chief C. & M.	1891
Wilcox, Albert W., Laredo, Tex.	I. & G. N.	1891
Wiley, T. R., Gibson City, Ill.	I. C.	1891
Wakefield, Wm., Lake Benton, Minn.	C. & N. W.	1891
Warder, A. S., Jr., Grafton, W. Va.	B. & O.	1891
White, Joseph A., Richmond, Va.	C. & O.	1892
Webb, W. S., Northington, Minn.	B. & N.	1892
Weaver, W. Warren, Philadelphia, Pa.	E. & O.	1892
Wheaton, C. A., St. Paul, Minn.	Chief St. P. & D.	1892
Wagenseller, B. F., Selin's Grove, Pa.	Penna.	1892
Woods, D. L., Dighton, Kan.	A. T. & S. F.	1892
Woodward, C. M., Tecumseh, Mich.	C. J. M.	1892
Wagner, J. K., Van Horne, Ia.	C. M. & St. P.	1892
Warren, L. J., Clay Center, Kan.	C. R. I. & P.	1892
Wedge, A. C., Albert Lea, Minn.	C. M. & St. P.	1892
Walte, J. P., Plainview, Minn.	C. & N. W.	1892
White, C. A., Danville, Ind.	I. & St. L. Div. of Big Four.	1892
Winslow, C. W., Oakley, Kan.	U. P.	1892
Walte, Jas. E., Lodi, O.	B. & O.	1892
Walton, J. C., Reidsville, N. C.	R. & D.	1892
Winans, H. M., Muncie, Ind.	Big Four.	1892
Wilson, R. M., Hope, Ark.	St. L. I. M. & S.	1892
Wilcox, Hamilton, Albert Lea, Minn.	Asst. M. & St. L.	1893
Welborn, G. W., Stewartville, Ind.	P. D. & E.	1893
Walter, A. F., Gladbrook, Ia.	C. & N. W.	1893
Warren, J. N., Sioux City, Ia.	Chief S. C. & N.	1893
Woodward, H. H., Melbourne, Ia.	C. M. & St. P.	1893
Weitz, J. A., Montpelier, O.	Wabash.	1893
Woods, Jas., Schuyler, Neb.	U. P.	1893
Wallace, R. B., Union, Neb.	M. P.	1893
Wilson, Willis M., Curtis, Neb.	B. & M. R.	1893

Wireback, I. J., St. Petersburg, Pa.	P. & W.	1891
Wheeler, H. C., Corbendale, Pa.	D. & H. C.	1891
Whitten, E. M., Nebraska City, Neb.	Asst. B. & M. R.	1889
Witter, W. L. M., Milan, Mo.	C. R. & K. C.	1891
Wiley, T. W., McKinney, Tex.	H. & T. C.	1891
Winton, Chas. F., Washington, Ind.	O. & M.	1890
Williams, O. A., Versailles, Mo.	Mo. Pac.	1889
Wylie, S. M., Paxton, Ill.	L. E. & W.	1892
Winston, R. F., Thayer, Mo.	K. C. F. S. & M.	1893
Wood, M. L., Montgomery, Ala.	A. M. & S. A. & M.	1892
Wilkes, B. A., Bowling Green, Mo.	C. A. & St. L.	1892
Williams, J. R., White Pigeon, Mich.	L. S. & M. S.	1891
Wooster, Chas. M., Tariffville, Conn.	P. & R.	1893
Wiluts, J. R., Fredonia, Kan.	A. T. & S. F.	1893
Wimer, T. H., Marshall, Minn.	G. N.	1893
Wedding, S. J., Rosine, Ky.	N. N. & M. V.	1893
Wysor, John C., Montgomery, W. Va.	C. & O.	1891
Whitehead, John, Salisbury, N. C.	R. & D.	1891
Wilson, Geo. W., Tipton, Ia.	C. & N. W.	1891
Williams, O. B., Andrews, Ind.	Wabash.	1891
Wagley, T. J., Cleburn, Tex.	G. C. & S. F.	1891
Weir, Sam'l D., Sullivan, Ind.	E. & T. H.	1893
Workman, H. M., Tracy, Minn.	C. & N. W.	1891
Wilkinson, C. H., 2017 Market St., Galveston, Tex.	G. C. & S. F.	1891
Wilson, Geo. W., Marysville, Mo.	Wabash.	1893
Winterrowd, N. S., Atchison, Kan.	M. F.	1893
Welsh, D. Emmett, Grand Rapids, Mich.	G. R. & I.	1893
Wile, Wm. C., Danbury, Conn.	N. Y. N. H. & H.	1893
Walker, Chas. I., Powers, Mich.	C. & N. W.	1893
Weeks, A. J., Correctionville, Ia.	I. C.	1891
Wilkerson, Marion, Sabina, O.	G. R. & I. Div.	1891
Wardell, J. M., Cadillac, Mich.	C. & M. V.	1891
Williams, W. W., Mattoon, Ill.	I. C.	1891
Warfield, Clarence, Durango, Mex.	Mex. Inter.	1892
Wilson, Benj. R., Titusville, Fla.	J. Y. & K. W.	1892
Whitford, Henry K., Elgin, Ill.	C. M. & St. P.	1892
Wallace, G. C., Rock Rapids, Ia.	B. C. R. & N.	1892
Williams, J. Cal., What Cheer, Ia.	C. & N. W.	1892
Wear, Isaac N., Fargo, N. D.	C. M. & St. P.	1891
Williams, R. R., Manning, Ia.	C. & N. W.	1891
Whitfoot, Robt. M., Bozeman, Mont.	N. P.	1892
Williams, W. H., Wall Lake, Ia.	C. & N. W.	1892
Weidman, W. M., Reading, Pa.	N. & W.	1891
Woodworth, W. H., Corning, O.	T. & O. C.	1891
Walker, R. L., Mansfield Valley, Pa.	P. C. C. & St. L.	1889
Whitaker, H. W., Columbus, O.	C. A. & C.	1893
Willis, C. D., Greenville, Tenn.	E. T. V. & G.	1892
Wooding, Benj. F., Trinidad, Colo.	D. & R. G.	1891
Wahl, G. F., Bremen, Ind.	B. & O. Dist.	1891
Warfield, R. B., 214 W. Franklin St., Baltimore, Md.	B. & O.	1891
White, L. R., Scandia, Kan.	M. P.	1890
West, W. B., Ft. Worth, Tex.	H. & T. C.	1891
Young, Seymour B., Salt Lake City, Utah.	Chief Utah Cent.	1892
Young, Geo. M., Evansville, Ind.	Chief E. & T. H.	1890
Yancy, Edwin, F., Sedalia, Mo.	Chief M. K. & .	1889
Yates, Oscar E., Holland, Mich.	C. & N. W. Div.	1891
Young, J. W., Bloomfield, Ia.	Wabash.	1891
Young, Robert S., Concord, N. C.	R. & D.	1891
Zeru, J. G., Lehigh, Pa.	L. V.	1891
Zopf, W. J., Findlay, O.	Asst. F. Ft. W. & W.	1893
Ziegler, J. L., Mount Joy, Pa.	Penna.	1893
Zimmerman, H. A., Youngstown, O.	A. Y. & P.	1891
Ziegler, Jas. P., Mount Joy, Pa.	Penna.	1893

Constitution and By-Laws.

CONSTITUTION.

ARTICLE I.

Name—The name of this association shall be called "The National Association of Railway Surgeons."

ARTICLE II.

Objects—The objects of this association shall be to promote acquaintance and fraternal relations among railway surgeons, to secure interchange of ideas and the adoption of the best methods of the development and improvement of railway surgery, and to establish it as a special branch of the surgical art.

ARTICLE III.

Members—There shall be two classes of members, active and honorary. The active members shall be surgeons of railway companies at the time of their admission to membership, provided, however, that when a surgeon is once a member his retirement from the service of the company shall not forfeit his membership.

The honorary members shall comprise such persons, not necessarily railway surgeons, as may from time to time be elected by a two-thirds vote of this association.

ARTICLE IV.

Officers—The officers of this association shall consist of the president, seven vice president, a secretary and assistant secretary, a treasurer and an executive committee of seven, who shall serve until their successors are elected: four to be elected in even years and three in odd years.

ARTICLE V.

Duties of Officers—Section 1. The president shall preside at all regular and special meetings and perform all the other duties that custom and parliamentary usage may require, and deliver an address at the meeting over which he presides.

Sec. 2. In the absence of the president the vice presidents shall perform the duties of his office in the order of their election.

Sec. 3. The secretary shall keep a record of the proceedings of all meetings and draw all orders on the treasury for the payment of bills, shall attend to all correspondence of the business of the association, notify all members of meetings, and upon request of the chairman give notice of meetings of committees during recess of the association, and upon request of the president shall issue such circular letters regarding the business of the association as may be deemed desirable, and shall be ex-officio a member of the committee on arrangements.

Sec. 4. The treasurer shall have immediate charge of the funds and property of the association, shall collect all dues, giving his receipt therefor, and shall give bond to the president to faithfully account for all funds coming into his possession belonging to this association; the amount of the bond to be determined by the executive committee. He shall also make a written statement to the president of the financial condition of the association within one month after the annual

meeting. He shall communicate each year with all the members who have not paid their annual dues and solicit payment of the same.

Sec. 5. The executive committee shall fix the annual dues and membership fee, subject to the approval of the association, and act as a committee on credentials, audit all accounts and, in conjunction with the other officers of the association, hold any necessary meetings in the interval between sessions deemed desirable and necessary in the interests of the association, and such conjoined action shall be deemed an action of the association as a whole.

ARTICLE VI.

Amendments—No amendments or alteration shall be made in any of these articles except at the annual meeting next subsequent to that at which such an amendment or alteration may have been proposed, and then only by the voice of two-thirds of all the members in attendance.

BY-LAWS AND RULES OF ORDER.

The order of business at the annual meeting of this association shall at all times be subject to the vote of two-thirds of all the members in attendance and until permanently altered, except when temporarily suspended. It shall be as follows:

1. Roll call.
2. Reading minutes of previous meeting.
3. Report of executive committee on the credentials of members.
4. Selection of nominating committee, afternoon of first day.
5. Election of officers, afternoon session second day.
6. Reports of committees and officers.
7. Reports of cases.
8. New business.
9. Reading and discussing papers.
10. Unfinished business.
11. Adjournment.

STANDING COMMITTEES.

1. Committee on arrangements.
2. Committee on transportation.
3. Committee on necrology.
4. Committee on publication.
5. Nominating committee.

DUTIES OF COMMITTEES.

1. The committee on arrangements shall be composed of five active members of this association, the majority of whom shall be actual residents of the town or city in which the annual meeting next succeeding their selection is held; they shall be required to provide suitable accommodations, including committee rooms, together with a list of hotels and rates per day, to receive and announce all essays and memoirs and publish the title and name of the author of the same in the programme for their meeting, which programme shall be sent to all members entitled to seats in the annual meeting at least three weeks prior to the date of such meeting, and make any other necessary arrangements.

2. It shall be the duty of the committee on transportation to ascertain the terms and conditions upon which the various railway lines will carry the members to and from the place of meeting, and to notify each member of the association through the committee of arrangements, or otherwise, of the same at least one month prior to the annual meeting.

3. The committee on necrology shall report annual brief biographical notes of deceased members, and preserve statistical and other memorial records of the society.

4. The committee on publication shall be composed of the president, secretary and treasurer, and shall have charge of preparing for the press such of the proceedings of the society as may be ordered to be published. And they shall have full discretionary power to omit from the published transactions any part or whole of any paper that may be referred to it by the association, unless especially instructed to the contrary by the vote of the association.

5. The nominating committee shall consist of seven members to be appointed by the president of the association at the afternoon session of the first day of the meeting of the association. It shall be the duty of this committee to report to the association, at the opening of the afternoon session on the second day, a list of nominees to fill the offices and standing committees provided for in these by-laws; and also to nominate the place of meeting for the next annual session.

MEETINGS.

The annual meeting of this association shall be held between the first and last Mondays of May in each year at the place agreed upon by the association, the preceding year, the particular date to be fixed by the executive committee and notice sent to each member of the association not later than October of the current year. The session shall continue three days, or until all the business of the society is completed and a formal adjournment had.

Special meetings may be held upon the call of the president of the association, signed by the secretary, at the request of a majority of the officers of the executive committee, and the business to be considered must be specified in the notification to be sent to each member of the association.

QUORUM.

The members present at any regular or special meeting shall constitute a quorum, and the majority vote decides all questions, unless otherwise provided for.

ELECTIONS.

The election of officers and the vote by which the place of holding meetings is decided shall be by ballot.

RULES.

The rules of conducting business shall in all cases as far as they are applicable and not incompatible with the constitution and by-laws of this association, be those in Cushing's Manual.

MISCELLANEOUS.

No report or other paper shall be entitled to publication in the journal for the year in which it shall be presented to the association unless it be placed in the hands of the committee on publication on or before the first day of July.

Any active member who shall fail to pay his dues for two successive years shall be dropped from the roll of active members, after having been notified by the treasurer of the forfeiture of his membership.

Any one appointed on a special committee who fails to report at the meeting next succeeding the one at which he is appointed shall not be continued on such committee, or appointed on any other, unless a satisfactory excuse is offered.

AMENDMENTS.

Resolutions amending, repealing or adding to these by-laws shall require a two-thirds vote of the members presents.

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or before the date last stamped below.

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